

**JANUARY  
1961**

PRICE 75 CENTS

# **ELECTRICAL CONSTRUCTION AND MAINTENANCE**

WITH ELECTRICAL CONTRACTING

**Outlook for 1961, an upturn in new construction and electrical system modernization is predicted.** page 63

**Institutional modernization, a case study in design and construction details of a primary distribution system renewal.** page 66

**Setting up a motor rewind facility for repairs and servicing of industrial plant electrical equipment.** page 78

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60TH YEAR

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	D	C	B	A		D	C	B	A
2-lite	52 FC	59 FC	67 FC	71 FC	2-lite	48 FC	54 FC	62 FC	66 FC
3-lite	78 FC	89 FC	101 FC	107 FC	3-lite	72 FC	81 FC	95 FC	99 FC
4-lite	99 FC	113 FC	129 FC	136 FC	4-lite	91 FC	105 FC	118 FC	125 FC

Notes: Room index D is for 30' x 36' room using 3-28' rows  
Room index C is for 40' x 48' room using 4-40' rows

Room index B is for 50' x 56' room using 5-48' rows  
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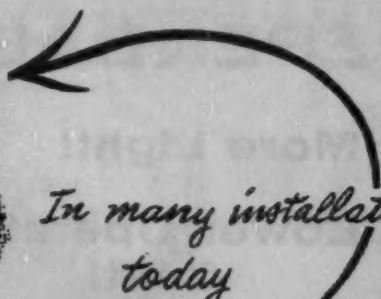


ratings shown on the label or on the product. Circuit-breakers (g) Non-interchangeable Circuit-Breakers. Circuit-breakers used for lighting and appliance branch circuits in residential and other occupancies except where the conditions of maintenance and supervision assure that overcurrent protective devices and branch circuit wiring will be maintained at proper rating, shall be non-interchangeable in accordance with the following provisions:

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Amperes
0- 20
21- 50
51-100

(2) Such circuit-breakers or their multiple mounting and bussing means shall be so arranged that it will be difficult after



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# ELECTRICAL CONSTRUCTION AND MAINTENANCE

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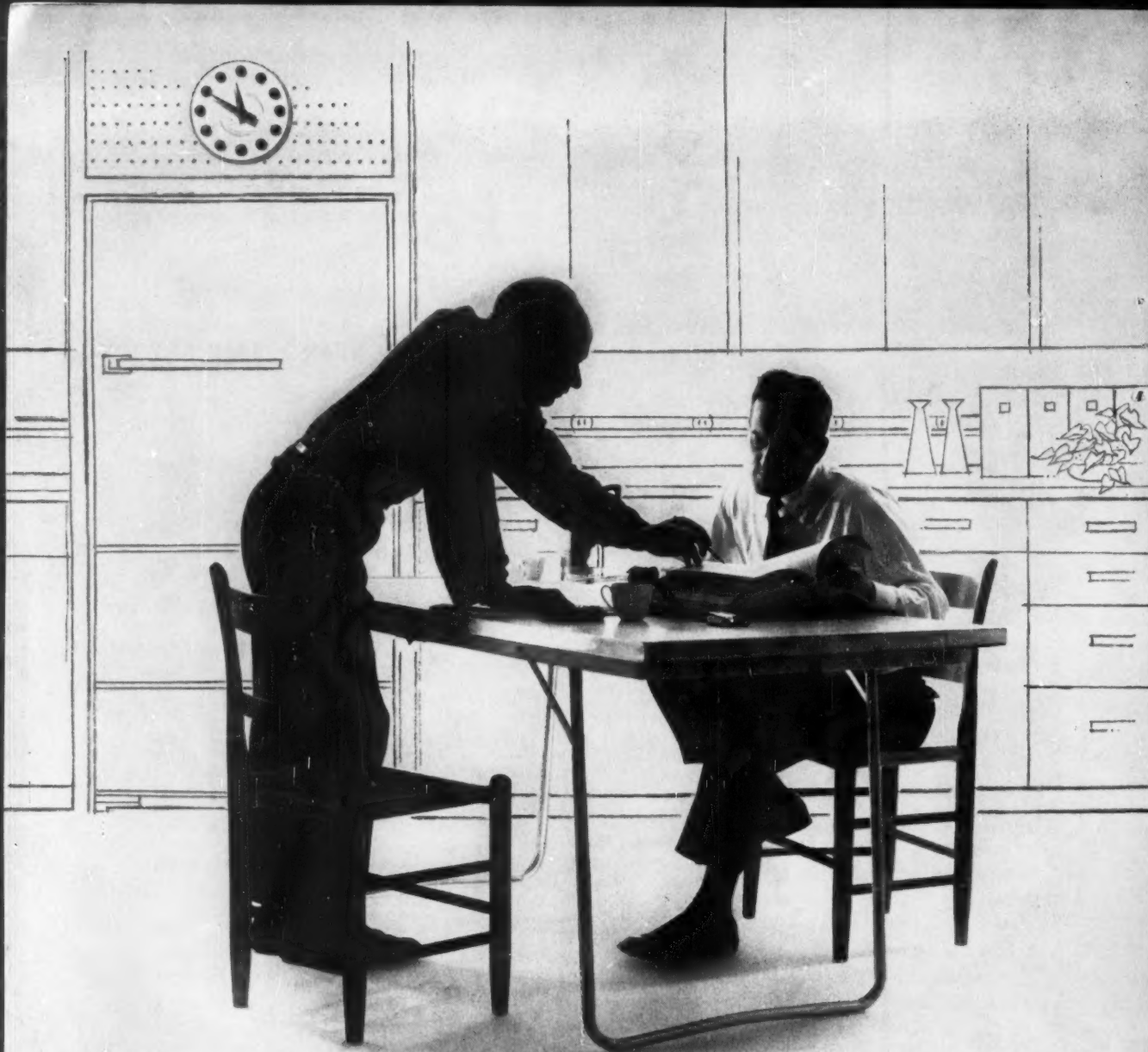
Published for electrical contractors, electrical departments in industry, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management in the field of electrical construction and maintenance.

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JANUARY 1961

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# Sidelights

## OUTLOOK

While many parts of the economy are viewing the months ahead with some uncertainty the electrical construction industry can look forward to quite favorable and encouraging prospects for the new year. Current forecasts see small but significant gains ahead in business volume in new construction, while technical obsolescence of existing electrical systems will generate substantial demands for electrical modernization. Estimated volume of electrical work in various categories of construction are projected for the year in "Outlook for 1961" beginning on page 63.

## NATIONAL ELECTRICAL WEEK

National Electrical Week will be observed February 5 to 11, throughout the country. The theme for 1961 is "Make Electricity Work for You." NEW is the electrical industry's broadest promotional project and participation is open to all. In many communities, local NEW committees will be active, sponsored by utilities or electric leagues. Contractors wishing to tie in should contact their local groups first. If no local group has been formed, write or phone the National Electrical Week Committee, Suite 306, 407 N. Eighth St., St. Louis 1, Mo., Central 1-1733. A broad range of promotional materials are available at nominal cost.

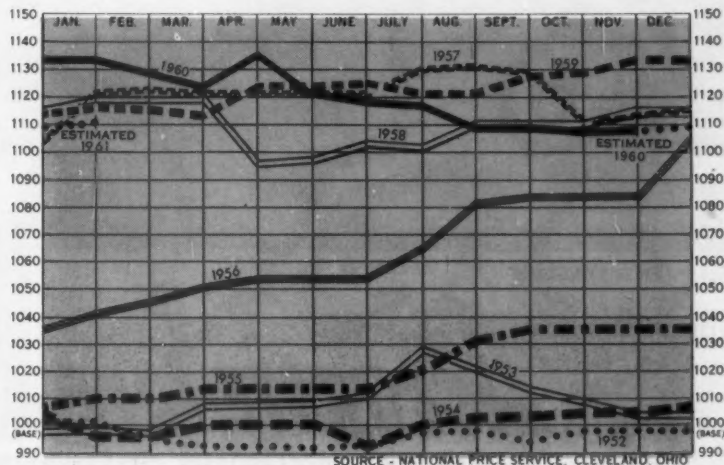
Since a great deal of consumer promotion in TV, radio, national magazines and newspapers will be concentrated during the week, active participation by electrical contractors through window displays, truck signs and similar devices can be valuable and rewarding. Be sure to identify your firm and services with National Electrical Week.

## RESIDENTIAL WIRING

The most stubborn problem of new house wiring today is the tract home, built to a price, with a basic minimum wiring system. Medallion home promotion is a powerful force helping the industry provide better systems. But there is much that the individual contractor can do on his own initiative to "sell up" the job to a bigger and better value for the customer. For the February issue we have scheduled a detailed case study of a practical plan which is actually producing a 35% increase in billings on the average in conventional tract work. In the March issue we shall publish a special report on practical ways and means to sell up the residential wiring job. Don't miss these original and exclusive articles.

### ELECTRICAL MATERIALS COST INDEX

BASE LINE IS 1000 AND REPRESENTS COSTS OF A TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. THE INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.





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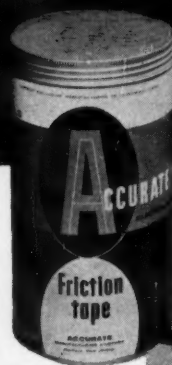
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RUBBER  
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# Washington Report

JANUARY • 1961

**The current sluggishness in business should end by spring**, in the opinion of Governor Luther Hodges, new Secretary of Commerce in the Kennedy Administration. Various economists, both in government and in industry, have also expressed mild optimism for a slow pickup beginning in the second half of 1961. At the end of 1960, most economists agreed that the national economy was in a recession, or "contraction," but at a high plateau. Some economists predicted still higher unemployment, lower income, reduced production during the first few months of 1961, and a possible unbalanced Federal budget for as much as two years in a row. Other factors contributing to the current slowdown in business include cuts in capital spending, continuing liquidation of inventories, and declining shipments by manufacturers. The outlook was recently summarized by Louis J. Paradiso, of Dept. of Commerce's Office of Business Economics, when he testified before the Joint Economic Committee of Congress that "at the present time no major forces are in sight to provide the upward thrust needed for resumption of economic growth."

**Industrial production declined in November** to the lowest point in a year—105% of the 1957 average. On the other hand, output of electricity topped 15 billion kwhr for the week ending December 17, a record.

**New construction spending went up 1% in November**, on a seasonally adjusted basis, to an annual rate of \$55.3 billion. Construction outlays in 1961 are expected to rise 4% above 1960's total of about \$55.1 billion, to a record \$57.3 billion. November construction spending totaled \$4.8 billion, 2% higher than in November 1959. This consisted of \$3,374 million private expenditures, and \$1,427 million public expenditures.

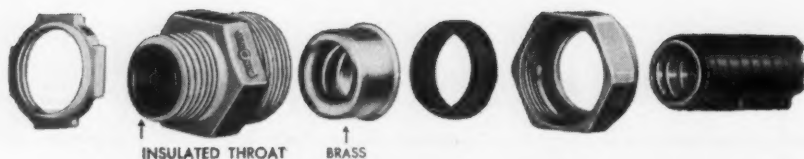
Public works spending picked up briskly during the last half of 1960, and is expected to rise to \$17.1 billion this year. Roads and highways are expected to total \$6 billion this year, up \$300 million over 1960. Also school construction is forecast at \$3.1 billion for 1961, up \$225 million from last year.

Industrial building last year plunged ahead of 1959 totals by 38%, are forecast for 1961 at \$3.1 billion, up \$200 million from 1960. Also, commercial construction is placed at \$4.2 billion for 1961, aided by the continuing boom in office building.

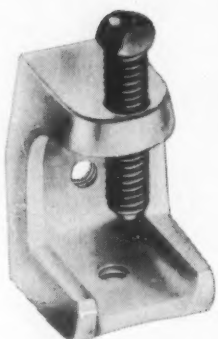
**Private residential construction spending should exceed 1960's total by 3% this year**, and total about \$22.6 billion, Dept. of Commerce has predicted. This is below the record of \$24.5 billion chalked up in 1959. Measured in housing starts, actual starts for the first 11 months of 1960 were 1,176,000, or 17% below the similar 1959 period. The seasonally adjusted annual rate in November was 1,235,000 units.

## **Miscellaneous economic highlights:**

- **Consumers Price Index** (cost-of-living) rose to a record 127.3% of average 1947-49 prices in October. More than a million workers received increases of about 2 cents per hour as a result.
- **Unemployment** hit a total of 4,031,000 in November, highest for any November since World War II. Continued rises in unemployment are predicted by Labor Dept., to a possible 5.3 million in February.
- **Personal income** in November leveled off at the October rate of \$409.6 billion, mirroring the earlier declines in production on nationwide employment.



Malleable Iron Liquid-Tite Connectors



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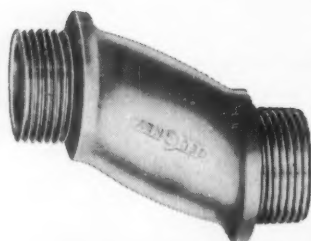
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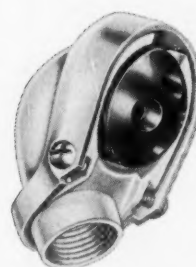
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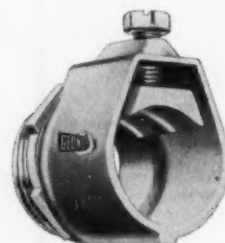
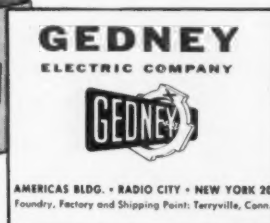
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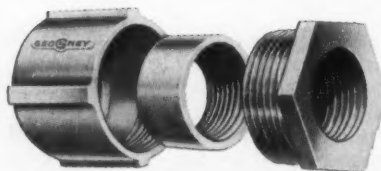
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& Non Metallic Connectors



M.I. 3 Piece Conduit Couplings

# How American Industry Points The Way To Sustained Prosperity in 1961

Something new and very constructive is happening in American industry. It promises to add a major element of strength to business not only in 1961 but right along over the years ahead.

What is happening is essentially this. American industry is planning to continue to invest heavily in new and better producing facilities in spite of the fact that it has an excess of capacity to produce its present range of products. And, by doing so, business is helping to shape a stronger American economy. For the continuation of a high level of capital investment by business is one of the most important keys to sustained prosperity.

News of this major new development in American industry is provided by the results of the McGraw-Hill Fall Survey of Business Investment Plans for 1961 and 1962, presented in detail at the right. The McGraw-Hill investment surveys, now in their 13th year, cover a broad cross-section of American industry.

How American industry is aiming to go ahead with a big investment program in spite of its present burden of excess producing capacity is highlighted by the plans of manufacturing companies. The McGraw-Hill fall survey finds that, on the average, these companies are using slightly less than 80 per cent of their producing capacity. They would like to be using well over 90 per cent.

## Dramatic New Departure

If historic investment patterns were being followed, our manufacturing companies, with only about 80 per cent of their capacity being employed, would be cutting back new investment programs drastically, and cutting down prosperity in the process. **But — and here is the dramatic new fact — they plan almost no cut-backs in their investment programs.** They plan to invest almost as much (within 3%) in 1961 as they are investing this year. And this year they are investing 19 per cent more than they did in 1959.

**There are two major reasons why American industry is unwilling to let its excess produc-**

PLANS FOR CAPITAL SPENDING  
(Billions of Dollars)

INDUSTRY	1959 Actual*	1960 Estimated*	1961 Planned	1960-1961 % Change	1962 Planned
Iron and Steel	\$1.04	\$1.52	\$1.37	-10%	\$1.18
Nonferrous Metals	.31	.34	.34	0	.32
Machinery	.91	1.15	1.11	-3	1.11
Electrical Machinery	.52	.52	.60	+10	.63
Autos, Trucks & Parts	.64	.89	.95	+7	1.02
Transportation Equipment (Aircraft, Ships, R.R. Eq't.)	.39	.41	.37	-10	.35
Other Metalworking	.88	.97	.85	-12	.87
Chemicals	1.24	1.61	1.64	+2	1.59
Paper and Pulp	.63	.75	.69	-8	.53
Rubber	.19	.24	.23	-4	.20
Stone, Clay and Glass	.53	.63	.56	-11	.55
Petroleum & Coal Products	2.49	2.45	2.52	+3	2.50
Food and Beverages	.82	.94	.99	+5	.97
Textiles	.41	.53	.42	-21	.40
Miscellaneous Manufacturing	1.07	1.28	1.21	-5	1.13
ALL MANUFACTURING	12.07	14.33	13.93	-3	13.35
Mining	.99	.99	.90	-9	.89
Railroads	.92	1.04	.79	-24	.83
Other Transportation & Communications	4.69	5.20	4.61	-11	4.18
Electric And Gas Utilities	5.67	5.89	6.14	+4	6.01
Commercial (1)	8.21	8.61	8.70	+1	8.54
ALL BUSINESS	32.55	36.06	35.07	-3	33.90

\*U.S. Department of Commerce, Securities and Exchange Commission, McGraw-Hill Department of Economics.

(1) Figure based on large chain, mail order and department stores, insurance companies, banks and other commercial businesses.

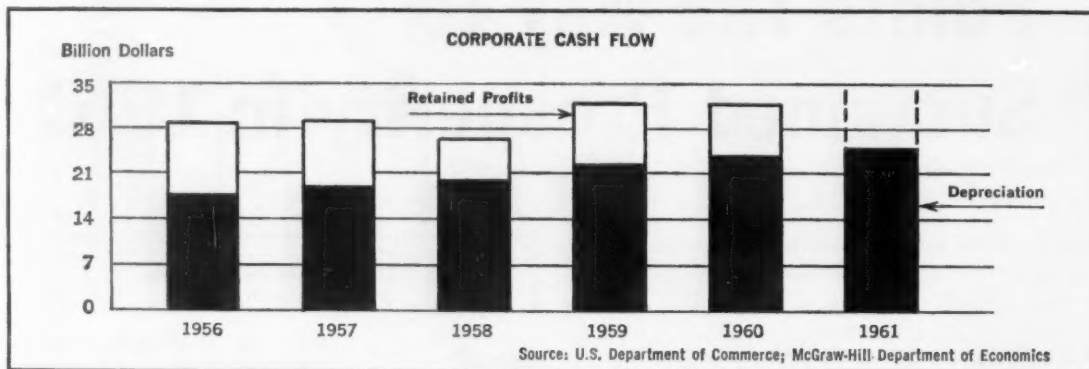
ing capacity stall its investment in new facilities until the capacity is more fully used. One is that a lot of this capacity is obsolete and costly to operate. Increasingly rugged competition is creating a strong inducement to replace this antique capacity with modern, more efficient equipment which is widely available.

## "R And D" Paves The Way

The steel industry provides a good case in point. Despite an operating rate of little more than 50 per cent during the last six months, steel companies plan a total investment of nearly \$1.4 billion in 1961. And though this is 10 per cent below their capital expenditures in 1960, it will still be the third highest year on record.

incentive and wherewithal to continue a vigorous program of new investment. In addition, if price inflation were to begin surging again, it would eat away the power of depreciation reserves to purchase new plant and equipment.

The allowances now permitted American industrial firms for the depreciation of their producing facilities are lower than those made in any of the industrial



Also, new investment is required to tool up for the manufacture of the new products being spawned by the continuing boom in industrial research and development. This year, we are spending about \$13 billion (that's *billion*) for all research and development, about \$9.6 billion of it through industry.\* And out of it is coming the "know-how" for a veritable flood of new products, processes and equipment, most all of these calling for new producing equipment. Next year, American manufacturers plan to get 12 per cent of their sales in products that did not even exist four years ago.

## Key Role Of Depreciation Reserves

A major reason why American industry can combine the desire to carry out big new investment programs with the necessary financial capacity to do it is to be found in the growth of its reserves for depreciation. This year, (1960), business has been in a squeeze between costs and the prices it could get for its products. This cost-price squeeze has reduced profits sharply. The total of profits for the year will be down about 5 per cent.

Allowances for the depreciation of existing plant and equipment, however, have continued to rise. The result is that the so-called cash flow of corporations (their retained profits plus their allowances for depreciation) is the same this year as last. And this cash flow, shown in the chart above, makes a decisive contribution to financing new investment.

## Inflation Would Be Deadly

If the sort of profit squeeze that has prevailed this year were to become chronic, it would blight both the

countries with which we are in increasingly tough competition. More adequate allowances would speed up the job of modernizing American industry. An earlier McGraw-Hill survey indicated that it would cost only slightly less than \$100 billion to bring our nation's plant and equipment up to date.

But at this juncture, American industry's eagerness and capacity to maintain a high level of investment capital is adding a great new element of constructive strength to the nation's economy.

\*The significance of this boom for American industry is analyzed in a new McGraw-Hill book, "The Research Revolution" by Leonard Silk, Economics Editor of BUSINESS WEEK. Together with other new business investment trends the "R & D" boom also constitutes a key part of another new McGraw-Hill book, "New Forces in American Business" by Dexter M. Keezer and associates — the November selection of the Business Book Club.

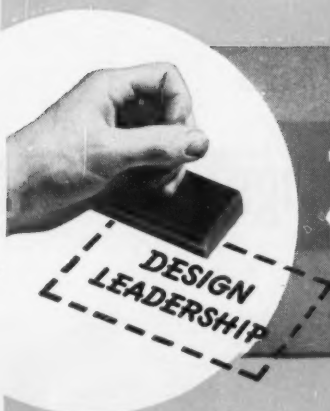
This message was prepared by my staff associates as part of our company-wide effort to report on major new developments in American business and industry. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or part of the text.

*Donald C. McGraw*

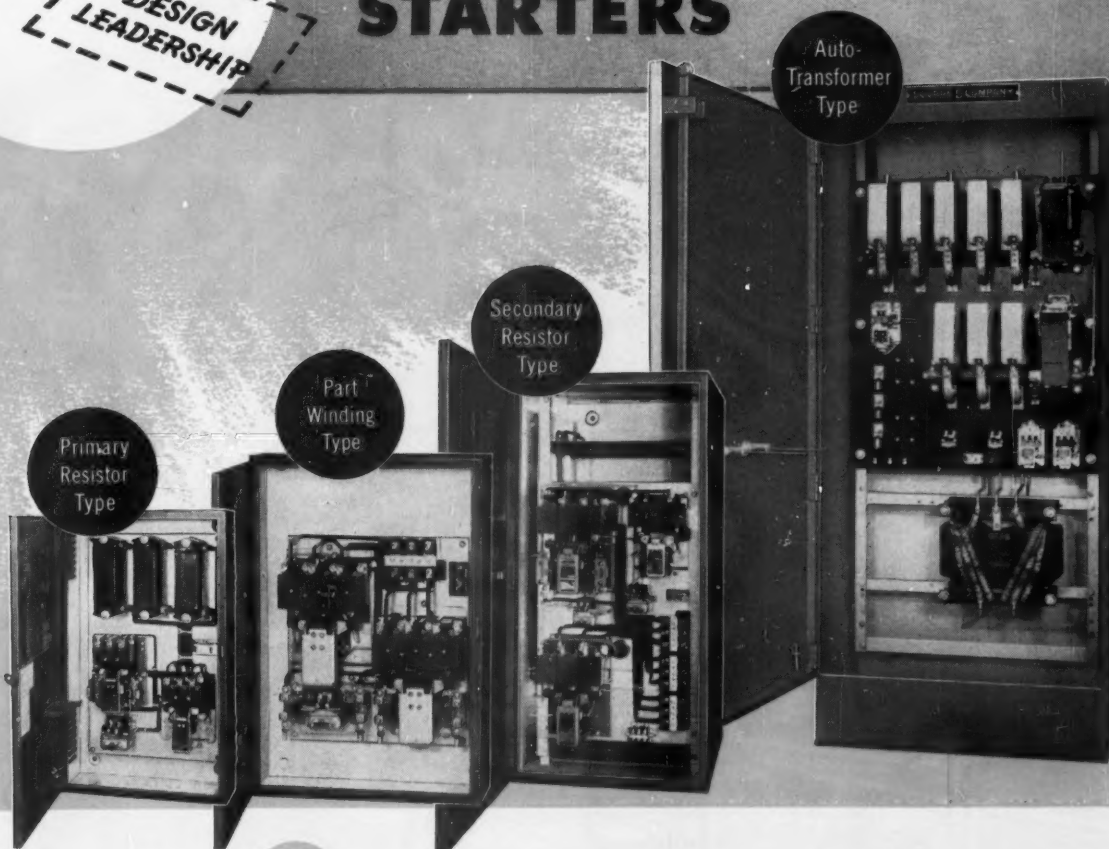
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# SQUARE D *Reduced Voltage* STARTERS



One of these **4** types will meet your requirements . . . **best**

- Is minimum motor current inrush your primary consideration?
- Is it reduced starting torque? • Or maximum smoothness in acceleration?
- Is cost an important factor?

With these four types Square D can meet any reduced voltage starter requirement—exactly.

*Write* for Reduced Voltage Starter Bulletins. They give complete details.  
Address Square D Company, 4041 N. Richards Street, Milwaukee 12, Wisconsin.

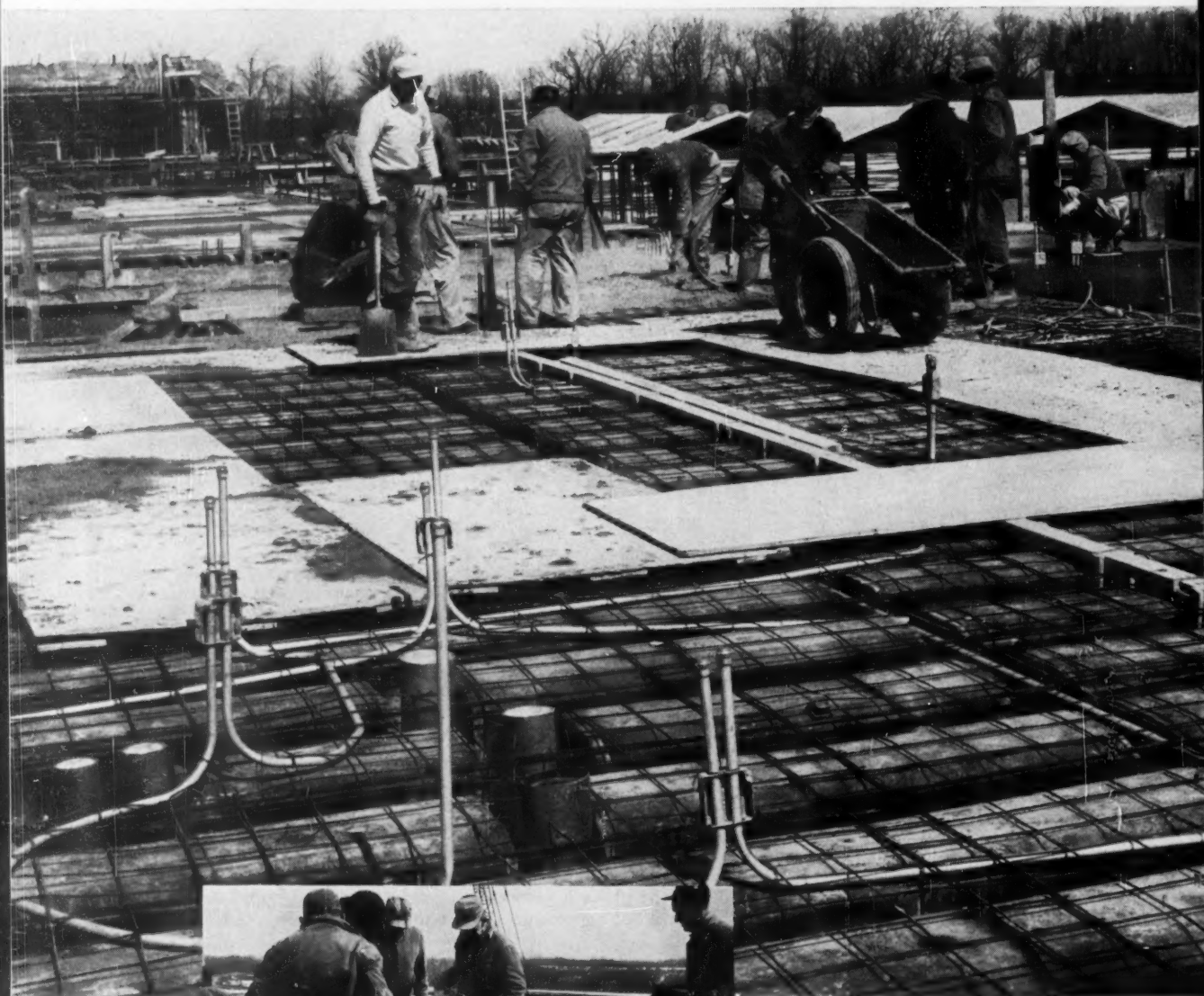


## SQUARE D COMPANY

wherever electricity is distributed and controlled

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . JANUARY, 1961

***St. Louis contractor praises***  
**"Uniform Bending... Definite Savings" of Republic**



Concrete? Millions of feet of ELECTRUNIT have been used over the past twenty-five years. That tight zinc coating stands up, resists corrosion. Highest quality! Republic ELECTRUNIT E.M.T. is produced to A.S.A. Specification C80.3, Federal Specification WWT-806 and carries the Underwriters' Laboratories Seal of Inspection.

# ELECTRUNITE E.M.T.

(ELECTRICAL METALLIC TUBING)



Maryknoll Junior Seminary, St. Louis County, Mo.  
Architects and Electrical Engineer, Leo A. Daly Co., St. Louis, Mo.  
General Contractor, Gamble Construction Co., St. Louis, Mo.  
Electrical Contractor, Kaemmerlen Electric Co., St. Louis, Mo.

Kaemmerlen Electric Company used Republic E.M.T. exclusively for all raceways in the new Maryknoll Junior Seminary, in St. Louis County, Mo.

Mr. H. Chub Winkelmann, Contracting Department Manager, writes how pleased he is with the results. He reports definite savings because of "your numerous added features such as INCH-MARKS, GUIDE-LINES, and easy pulling inside surface." Further, he likes the fact that, "uniform bending produces a neat and good mechanical installation."

Check Winkelmann's findings yourself. Put ELECTRUNITE E.M.T. to work on your jobs to take the hard work out of them. Exclusive features make installation easier, reduce wasted materials and let you pocket a profit. Pick up enough bundles from your electrical distributor to run your own tests. You'll find that, "The Best costs Less installed."

This STEELMARK of the American Steel Industry tells you a product is made of Steel. Look for it when you buy.



## REPUBLIC STEEL

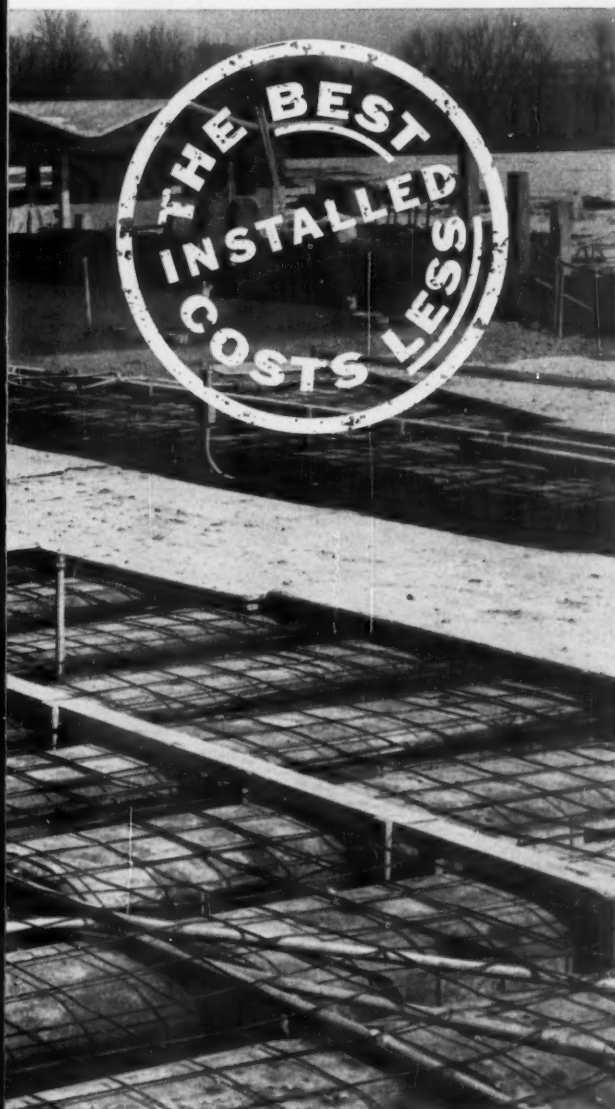
*World's Widest Range  
of Standard Steels and Steel Products*



**REPUBLIC STEEL CORPORATION**  
**STEEL AND TUBES DIVISION—DEPT. A-1453**  
**212 EAST 131st STREET • CLEVELAND 8, OHIO**

Please send more information about the installation advantages of Republic ELECTRUNITE® Electrical Metallic Tubing.

Name \_\_\_\_\_ Title \_\_\_\_\_  
Firm \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

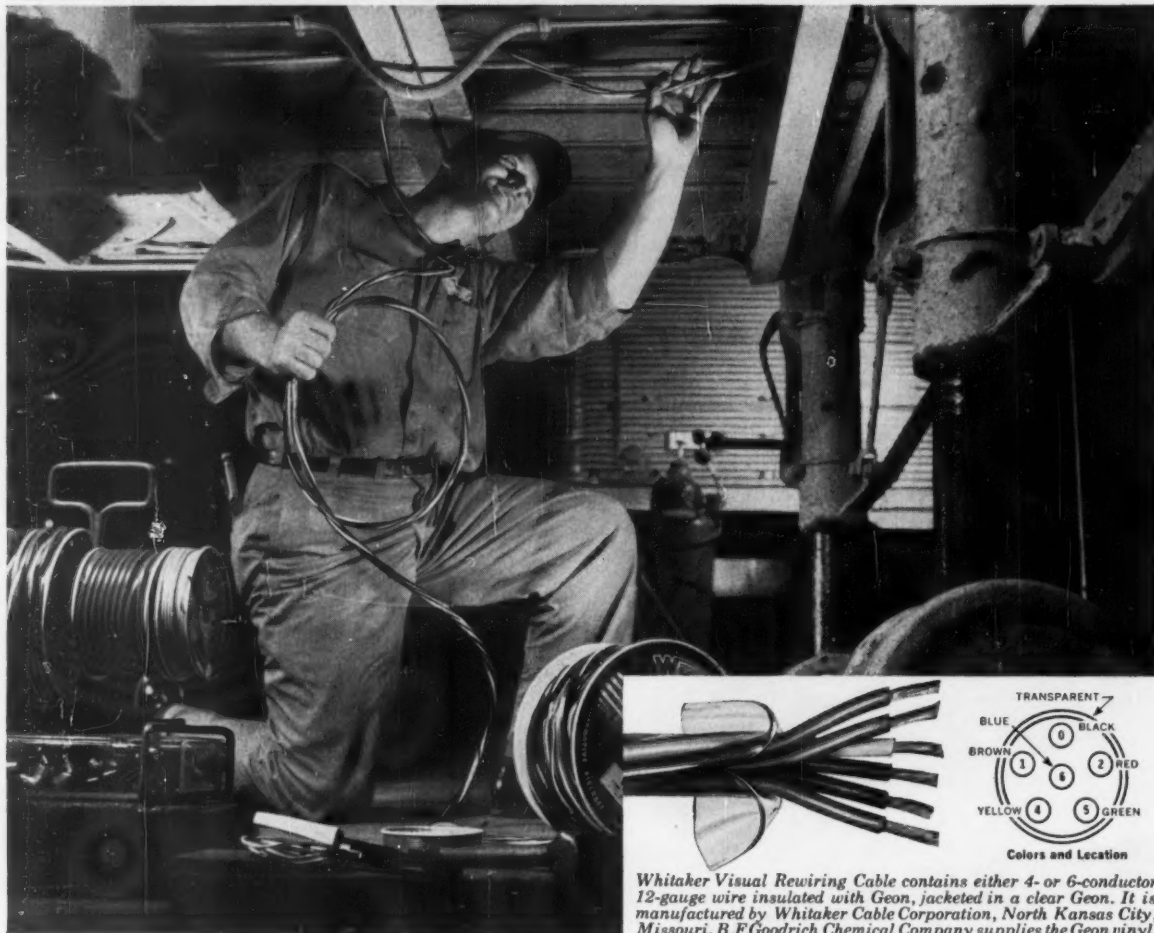


All bends in plane. "GUIDE-LINE"® keeps them there. All measurements accurate. "INCH-MARKS"® control this, save waste. All bends uniform and wrinkle-free thanks to the uniform ductility of ELECTRUNITE E.M.T. And, wire pulling up to 37% easier because of "INSIDE-KNURLING" and "SILVERSUCK"® surface.



Another new development using

# B.F. Goodrich Chemical raw materials



## Transparent cable jacket of Geon gives truckers see-through convenience

Designed to meet new ICC truck-trailer wiring requirements that call for higher-capacity electrical circuits, this new cable gives installers real convenience. Conductors insulated in various colors of Geon are contained in a jacket of clear Geon vinyl, so that locating wires for making connections is fast and easy.

At the same time, truckers get top quality electrical protection because

Geon gives excellent dielectric properties and good resistance to abrasion, weathering and heat. It is non-flammable, has low temperature flexibility and is extremely inert to oil, chemicals and solvents. Geon retains its properties over years of service.

Here's another example of the way Geon vinyl improves products. For information, write Dept. NQ-1, B.F. Goodrich Chemical Company,

3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.



**B.F. Goodrich Chemical Company**  
a division of The B.F. Goodrich Company



GEON vinyls • HYCAR rubber and latex • GOOD-RITE chemicals and plasticizers





# NEW... most beautiful Apartment Telephones ever made!

- Equipped with cordless loudspeaker or watchcase receiver—your choice
- Modern, slim, streamlined design
- Aluminum face plate with beautiful anodized finish in brushed gold or silver
- Plug-and-receptacle installation
- Easiest telephone in the world to install and maintain
- Excellent voice reproduction
- Competitive price
- Pleasant-sounding audible signal
- Flush, semi-flush or surface wall mounting

Auth vestibule and lobby telephones also have been re-designed and are the last word in appearance and efficiency. Get complete facts today.

*Apartment and vestibule telephones illustrated are cordless loudspeaking type. Also available are apartment telephones with watchcase receiver as indicated.*



*Exploded view of cordless loudspeaking telephone*

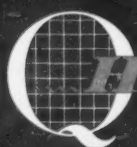


*Watchcase receiver type*



ELECTRICAL SIGNALING,  
TIME AND COMMUNICATION  
SYSTEMS FOR HOSPITALS,  
SCHOOLS, HOUSING,  
INDUSTRY AND SHIPS

**Auth Electric Company, Inc.**  
LONG ISLAND CITY 1, NEW YORK



dry-type  
transformers



Wall-mounting of this compact QHT transformer provides bonus floor space for equipment and personnel.

# Lighter, smaller General Electric QHT transformers give bonus floor space

*The new General Electric QHT dry-type transformers save you production space because they offer savings up to 50 percent in weight and 67 percent in size compared with competitive dry-types. QHT units up to 75 kva have built-in provisions for wall mounting, and larger units can be set in out-of-the-way places near the load, saving the cost of long, low-voltage feeders.*

**A new insulation system permits use** of smaller coils to reduce size and weight of QHT transformers. Inorganic silicone impregnated insulation is highly resistant to water, dust, and corrosive atmospheres. Also, aluminum conductors and cold-rolled, grain-oriented silicone steel combine to give you a smaller, lighter, quiet transformer designed for years of dependable service.

**QHT dry-type transformers are easy to install.** Units have conveniently placed, dual-sized knock-outs, large terminal compartments and wiring spaces. All wiring can be done from the front.

**QHT transformers are quiet**—at least 15 decibels quieter than older designs. All have sound levels equal to or less than NEMA standards.

**You can get 24-hour delivery** on most models from your nearby General Electric distributor. Call him for complete information, or write for GEA-6907A "QHT Specifier's and Buyer's Guide" to Section 411-16, General Electric Co., Schenectady 5, N. Y.

\* Registered trademark of General Electric Company for quiet, high-temperature dry-type transformers.

*Progress Is Our Most Important Product*

GENERAL  ELECTRIC

COMPARE . . . G-E Transformers are 32% to 67% smaller



	NEW QHT	TRANS. "A"†	TRANS. "B"†	TRANS. "C"†
<b>45 KVA</b>				
Height (in.)	26 1/4	41 1/4	30	32
Width (in.)	24	28 3/4	31	22
Depth (in.)	19	26	19	28 1/2
Weight (lbs)	430	780	790	500
Volume (cu. in.)	11,970	30,695	17,670	20,064
<b>225 KVA</b>				
Height (in.)	44 1/4	60	50	66 3/4
Width (in.)	41	54	56	55
Depth (in.)	24 3/4	30	28	37
Weight (lbs)	1500	2300	3000	2500
Volume (cu. in.)	44,902	97,200	78,400	135,836

† Transformers "A," "B," and "C" represent products of well-known transformer manufacturers. Data was taken from current published information.



The nearsighted **MISTER MAGOO** says... "1954? A significant year for the Magoo exchequer. I cannily invested in a galaxy of uranium stocks, and General Electric invented the Quartz Infrared Lamp. Happy birthday, Quartz Infrared! Confound it—they put two fuses on these new-fangled firecrackers and neither one works!"

© UPA PICTURES, INC.

Ed. N.



## INSTANT HEAT!

### G-E tubular Quartz Infra-red Lamp hits 4,000°F. in less than a second

... and two seconds after your customer turns off this pencil-thin lamp, 80% of its radiant energy is gone. Residual heat won't overheat his product.

Pour a glass of ice water over this lamp at full heat and — nothing happens! The quartz tube withstands violent temperature shock.

General Electric's tubular Quartz Infrared Lamps are made for jobs where high or low amounts of concentrated radiation are needed *fast*. Examples: cooking food; shaping plastics; drying paints, paper, inks and glue; heating people; testing aircraft at supersonic-flight temperatures.

In most cases, you'll be surprised how few lamps do the trick. You can produce concentrations of 10 to more than 10,000 watts per square foot. It's the most powerful infrared source of its size. Quartz

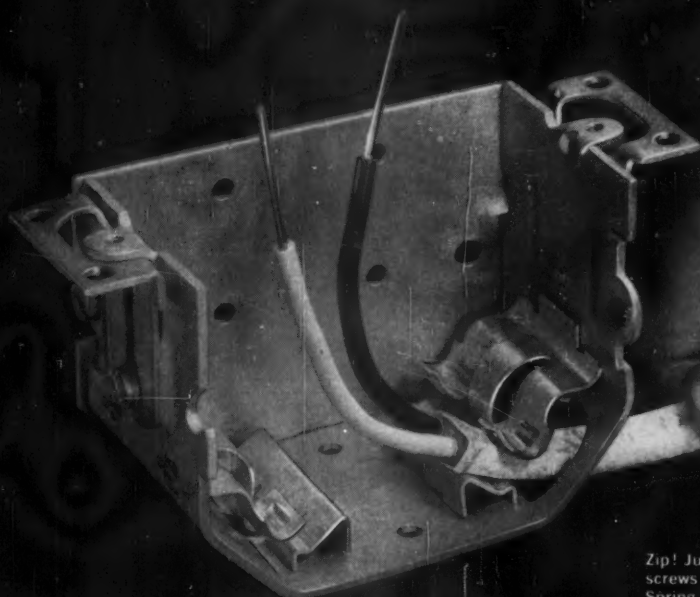
Infrared Lamps are simply constructed with a flexible wire at each end and can be installed economically. They've been proved in actual use for over six years.

Choose the exact size — 500 to 5000 watts — in 5" to 50" lengths at 100 watts per inch. Ask your General Electric lamp representative for information on how Quartz Infrared Lamps can help your customers. General Electric Co., Large Lamp Dept. C-11, Nela Park, Cleveland 12, Ohio.

*Progress Is Our Most Important Product*

**GENERAL  ELECTRIC**



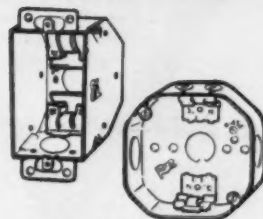


Zip! Just slide in the cable. No screws to loosen and tighten. Spring steel "Q" Quick Clamp holds non-metallic cable firmly.

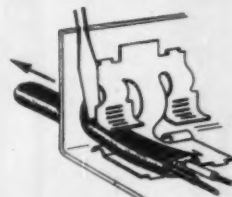
**RACO "Q" Quick Clamps** save you 10¢ on every installation... \$9<sup>00</sup> on the average home

Now...a new, faster way to install non-metallic cable...and save on every job. With the new RACO "Q" Quick Clamp, you just slide the cable in. No screws or screwdrivers. Holds cable tightly. Available in square-cornered switch boxes, beveled corner switch boxes and outlet boxes.

\*Trade Mark



Available in switch boxes (including beveled corner boxes) and outlet boxes.



To remove cable, release clamp pressure with screwdriver.



**ALL-STEEL EQUIPMENT INC.**  
Aurora, Illinois



**EASIER TO DO...  
and costs less too!**

**B-M**

**INDENTER  
FITTINGS and TOOLS**

Here is the combination that is unbeatable when it comes to easier E.M.T. installation at less cost. New lightweight plier size indenters make setting up thin wall conduit a breeze. B-M fittings are neater too! No unsightly nuts or projecting set screws.

A few more of the plus features of B-M fittings are Concrete tight—Vibration resistant—Extra heavy bright zinc plate, salt spray and acid drip tested for corrosion resistance—Extra heavy positive bonding lock-nuts—Smooth rounded edges or bushed throat type connectors that prevent insulation damage—All steel construction with extra heavy gauge wall thickness.



**Red Throat  
BM-21B  
1/2" Connector**



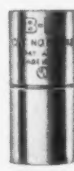
**Red Throat  
BM-22B  
3/4" Connector**



**Red Throat  
BM-23B  
1" Connector**



**BM-41  
1/2" Coupling**



**BM-42  
3/4" Coupling**



**BM-43  
1" Coupling**



**BM-21  
1/2" Connector**



**BM-22  
3/4" Connector**



**BM-23  
1" Connector**



**BM-No. 600  
Changeable  
Jaw Indenter**



**BM-No. 1000  
Handvise for 1/2",  
3/4" and 1" E.M.T.**



**BM-No. 100  
Cutter for 1/2",  
3/4" and 1" E.M.T.**



**BM-No. 607  
1/2" Indenter  
BM-No. 608  
3/4" Indenter**



All B-M indenter type fittings far exceed the requirements of U. L. file card E 10863 and Federal Specifications W-F-406.

**BRIEGEL METHOD  
TOOL CO.  
GALVA • ILLINOIS**

# PULLING OR PUSHING



***This combination  
has proved simplest and best  
in the field for  
ALL WIRE PULLING JOBS***

Why guess? Thousands of contractors have *proved* there's no substitute for high-tensile, spring *steel* in a fish tape. It won't break, fray or weaken—needs no special guides. With the Ideal spring-wound leader it feeds into outlet boxes and through difficult runs fast, smooth and easy. Then, Ideal "Wire-Lube" *slides* the cable through the conduit with least strain and effort. Contractors find there's nothing to equal this money-saving combination. You will, too!

flat STEEL tape  
in reel



ROUND

flexible  
leader

Music wire spring wound around a 20" airplane type cable slips into outlet boxes and around 90° bends like an eel. Hooks onto Ideal Fish Tape instantly. Takes up to 6 No. 10 bare wires. Tested for 400 lb. pull.

Oil tempered, high-tensile strength flat spring steel tape. Reel provides a high-leverage puller-pusher, protects hands, serves as a container. Tape can't spring loose. Completely safe on all jobs—no flying parts. No special instruction or supervision needed. Lengths 50 to 200 feet. Priced so low many contractors consider it a throw-away on the job!

SOLD THROUGH AMERICA'S LEADING DISTRIBUTORS

In Canada:  
Irving Smith, Ltd.,  
Montreal



easy sliding  
"WIRE LUBE"®



The pulling compound that takes the fight out of rubber, lead or plastic covered wire or cable as they are pulled into conduit and around bends and tight spots. Easily applied by hand or brush. Guards insulation against breaks, scrapes and strains. Dries to a fine lubricating powder that makes it easy to add or remove wires later. Non-corrosive, non-combustible, harmless to hands or clothes. For use in steel, aluminum or fiber conduit. Not for use with asbestos covered wire.

**If you aren't using this  
Ideal wire-pulling  
combination, better tell  
your Ideal Distributor you  
want to. Or mail coupon  
for free catalog data.**



Please send at once your catalog on Ideal time-saving wire pulling combination and other electricians' tools.

IDEAL INDUSTRIES, Inc. 5224-A Park Avenue, Sycamore, Illinois

Name \_\_\_\_\_  
Company \_\_\_\_\_ Title \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



FOR VOLTAGES OF 600 OR LESS

# There's a *Safe and Dependable* BUSS Fuse or FUSETRON Fuse to fit the needs of every user...

...AND FUSES PROVIDE THE HIGHEST DEGREE  
OF PROTECTION AVAILABLE

Unlike mechanically operated devices, fuses have no hinges, pivots or contacts to stick or get out of order. They require no periodic inspections, recalibration and corresponding down-time. A fuse is just as safe and accurate 20 years or longer after installation as it is on the day installed.



**Buss  
LOW-PEAK Fuses**  
200,000 amp. interrupting  
capacity... great current limita-  
tion... plus long time-lag.  
*Ask for Bulletin LPCS*



**FUSETRON  
dual-element Fuses**  
All purpose protective device  
for circuit, motor or equip-  
ment protection.  
*Ask for Bulletin FIS*



**Buss  
LIMITRON Fuses**  
High interrupting capacity fuses with  
exceptional current limitation.  
*Ask for Bulletin HLS*



**Buss  
Hi-Cap Fuses**  
For loads above 600 and  
up to 6,000 amps. 200,000  
amp. interrupting capacity,  
—plus current limitation.  
*Ask for Bulletin HCS*

BUSS makes a complete line of fuses for home, farm, commercial,  
electronic, electrical, automotive and industrial use.





**Buss Super-Lag  
Renewable Fuses**  
Lowest cost protection where  
periodic short-circuits are frequent.  
*Ask for Bulletin RCS*



**Buss  
One-Time Fuses**  
Low cost, safe protection for  
heating or lighting circuits where  
faults do not exceed 10,000 amp.  
*Ask for Bulletin NCS*



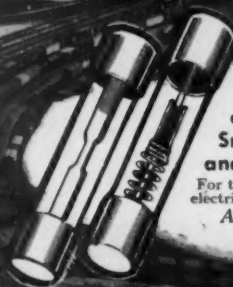
**Buss  
Clear Window  
Plug Fuses**  
One piece body, and "safety"  
design guarantee protection.  
*Ask for Bulletin WUS*



**Buss  
FUSTAT Fuses**  
Fusetron fuses with Type "S"  
base resist overfusing or  
tampering.  
*Ask for Bulletin SCPS*  
  
Fustats for motor protection.  
*Ask for Bulletin SMPS*



**FUSETRON  
dual-element  
Plug Fuses**  
Safely stop needless blows.  
Give full protection against  
short-circuits and overloads.  
*Ask for Bulletin TCPS*

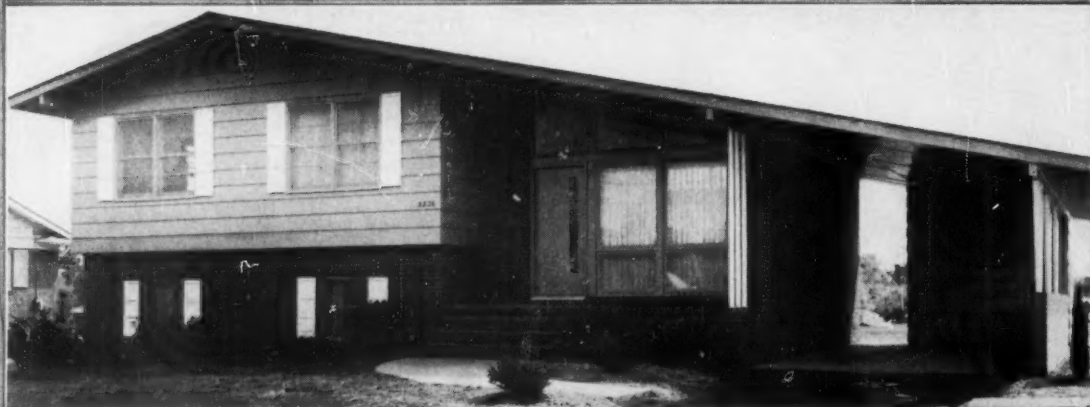


**BUSS  
and FUSETRON  
Small Dimension Fuses  
and Fuseholders**  
For the protection of all types of  
electric and electronic devices.  
*Ask for Bulletin SFB*

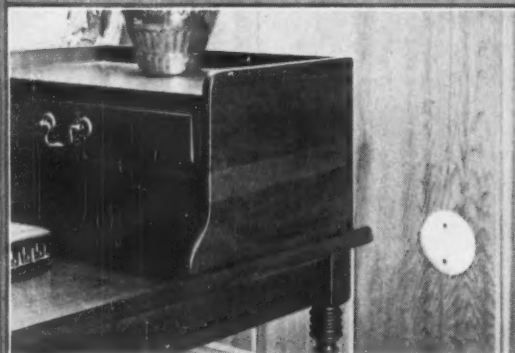
Get the  
Facts  
write

**Bussmann Mfg. Division, McGraw-Edison Co.**  
**University at Jefferson, St. Louis 7, Mo.**





"Concealed telephone wiring is part of the good planning you get from Ervin," says builder Charles C. Ervin. "It makes a more livable home, nicer rooms, and adds to resale value of the house."



Ervin homes are designed for families to grow in. Each home has several planned telephone outlets.

Your Telephone Business Office will gladly help you telephone-plan your homes. For details on home telephone installations, see *Sweet's Light Construction File, 11c/Be*. For commercial installations, *Sweet's Architectural File, 34a/Be*.

## "Ervin homes are quality homes, and concealed telephone wiring is part of our quality story"

**SAYS CHARLES C. ERVIN  
OF ERVIN CONSTRUCTION CO., CHARLOTTE, N.C.**

Ervin Construction Co., one of the largest home-building firms in the Southeast, is building close to 1000 homes this year—all of them with concealed telephone wiring.

"We've learned that concealed telephone wiring is a *definite* plus factor," says Mr. Ervin. "It's a competitive feature that homebuyers look for and appreciate. Ervin homes are quality homes, built with first-class materials, and concealed wiring is part of our quality story."

Ervin Construction Co. furnishes its building schedule to the telephone company. "They put in the wiring when the walls are open," says Mr. Ervin, "either by consulting with the homebuyer if the house is already sold, or by putting the outlets where their good judgment tells them."

### **BELL TELEPHONE SYSTEM**

Visit Booth 95 at the NAHB Convention in Chicago  
—for real money-making telephone tips.



# COLD WEATHER

# ?



## FREE SAMPLE! REG. U.S. PAT. OFF. **SCOTCH** BRAND **ELECTRICAL TAPE No. 88** **FIRST ALL-WEATHER ELECTRICAL TAPE**

Now at last a "super" tape to handle the toughest cold weather splicing jobs. New "SCOTCH" BRAND Electrical Tape No. 88 is 20% thicker than ordinary plastic tapes. Retains its easy handling properties and "feel" under all temperature conditions. UL approved. Resists acids, abrasion, alkalies, oils and weathering. Send in the coupon for free 9 ft. sample roll.

Made by the makers of "SCOTCH" BRAND No. 33 Electrical Tape.

SEE US AT THE Sixth National Electrical Exposition, Las Vegas Convention Center, Oct. 23-26, Booth 101.

MINNESOTA MINING AND MANUFACTURING COMPANY

... WHERE RESEARCH IS THE KEY TO TOMORROW



----- SEND IN TODAY -----

3M Co., 900 Bush Ave., St. Paul 6, Minn., Dept. EAA-11  
Send me a free sample roll of "SCOTCH" BRAND Electrical Tape No. 88

NAME

COMPANY

ADDRESS

CITY  STATE

**Electrical Products Division**

"SCOTCH" IS A REGISTERED TRADEMARK OF 3M CO., ST. PAUL 6, MINN.







# Hasn't sparked yet!

Another good reason why  
Alcoa aluminum electrical  
rigid conduit is gaining  
in popularity

You don't need special nonsparking tools with aluminum. It's nonsparking for safer installations.

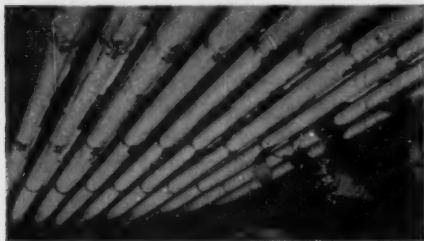
And, because Alcoa aluminum conduit *weighs less*, you can put it up faster. From warehouse to installation site you have only  $\frac{1}{3}$  as much weight to lift, load, carry and erect.

Cutting is fast—with hacksaw (or power tools on the larger sizes). Smaller sizes can be bent quickly, easily with an EMT bender. Use regular conduit dies (sharp ones, please!) and regular cutting oils for threading.

Wirepulling is easy too, since Alcoa aluminum conduit has a smooth, specially lubricated interior.

Competitively priced, aluminum conduit, also offers *corrosion-resistance, long life, good appearance*. Why not get all the facts and figures from your electrical distributor or one of our representatives.

Free literature on request. Just drop a line to Rome Cable Division of Alcoa, Dept. 7-11, Rome, New York.



Goes up faster Lightweight Alcoa conduit makes handling easier and faster—from warehouse to installation.

**ROME CABLE  
DIVISION OF ALCOA**

# ASCO Remote Control Switches with vibration mounts and soundproof enclosures provide QUIET operation

ASCO Mechanically Held Remote Control Switches have always been inherently quiet in open or closed position. The coil is energized only during the instant of operation; accordingly, the Switch is free from distracting A-C hum.

Now, through ASCO accessories, shock noises produced during opening and closing can be drastically reduced.

**Shock and Vibration Isolators** are easy to install—reduce operating noise normally audible from 250 ft. away to unobjectionable levels at 35 ft.

**Soundproof Enclosures**, when added to the shock and vibration isolators, reduce the sound of switch operation to a click faintly audible from a distance of only 3 feet.

## COMPLETE ACCESSORIES

Rugged, simple Bulletin 920 Remote Control Switches are available with:

**Adapter**—for control line fuse.

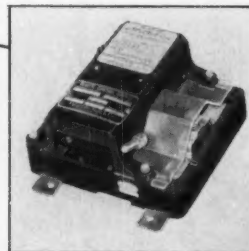
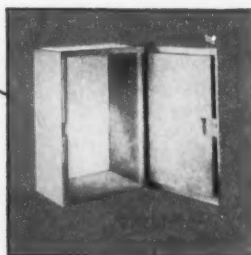
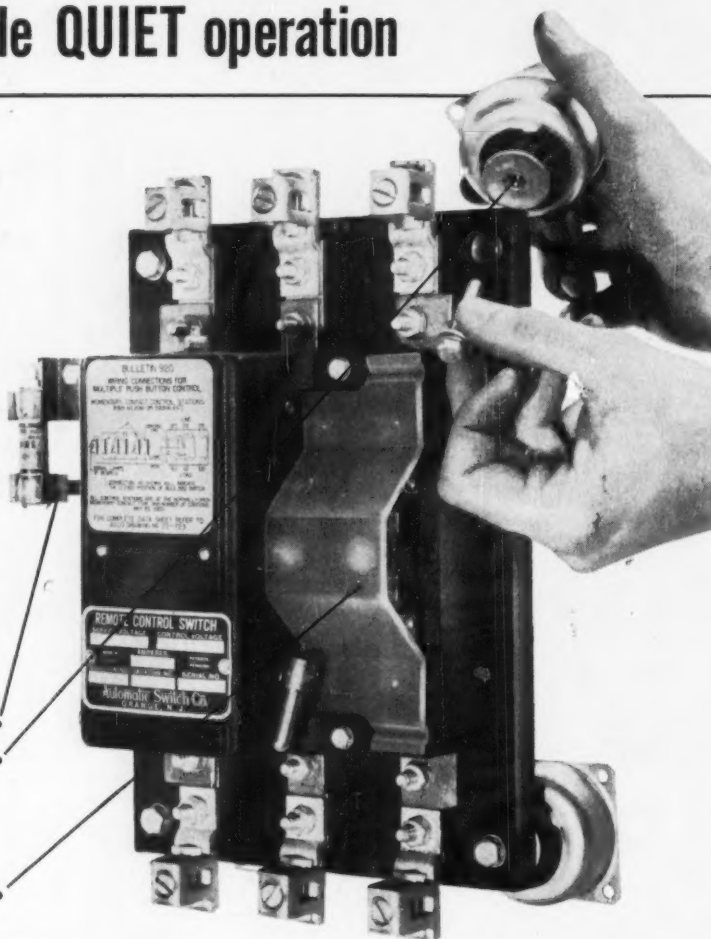
**Shock and Vibration Isolator Mounts**—provide efficient shock absorption, substantially reduce switch operating noise. Mounts are easily installed or removed—a single bolt holds each one to the panel.

**Cover Plate**—permits manual operation with complete protection from contacts.

**Reduced Width Dimensions**—for installations where space is at a premium. Reduced width 920 RC is only 5 $\frac{1}{8}$ " wide!

**Soundproof Enclosure**—with bonded acoustical insulation. Since ASCO switches are designed to operate in unventilated enclosures, derating is never necessary.

ASCO Bulletin 920 Switches equipped with low voltage control are suitable for 24-volt A-C control by push button, time switches, relays or other control methods—installation costs go down, safety and permissible line runs are increased.



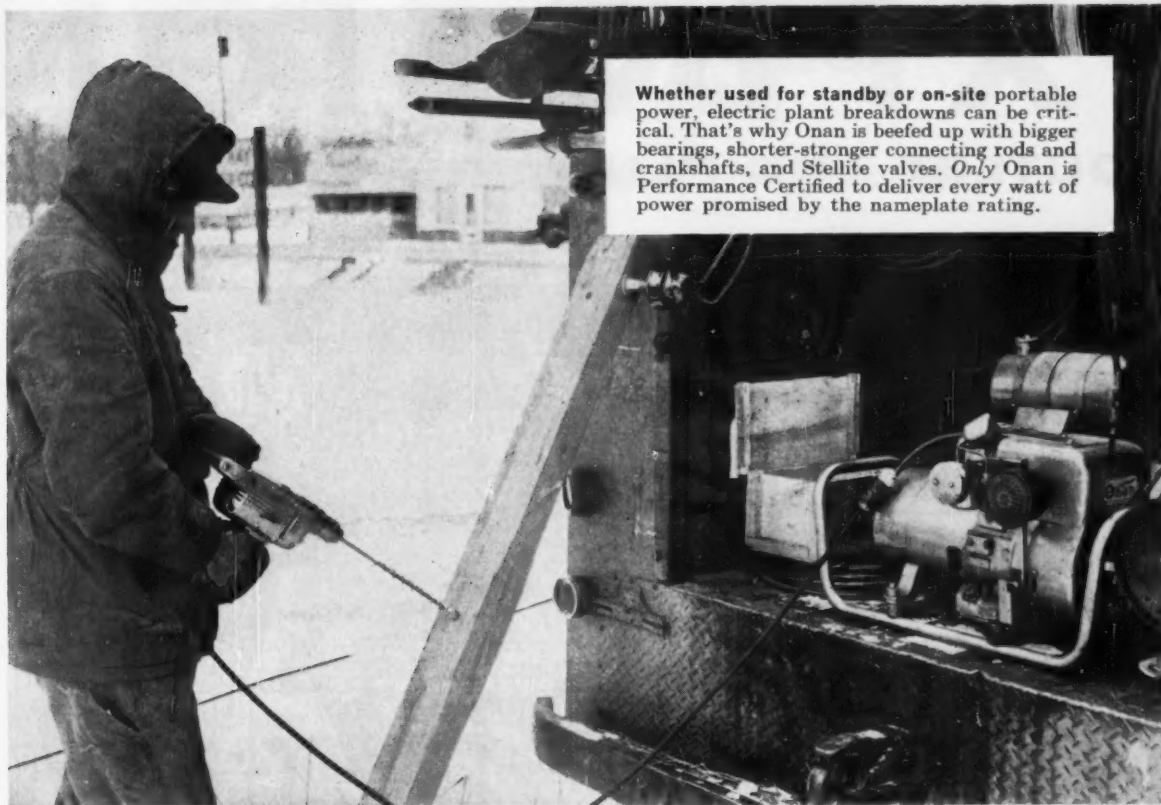
For complete data on ASCO Remote Control Switches and accessories, write for Catalog 57-52.

## ASCO Electromagnetic Control

Automatic Switch Co. 501 HANOVER RD., FLORHAM PARK, N. J., FRONTIER 7-4600

AUTOMATIC TRANSFER SWITCHES • SOLENOID VALVES • ELECTROMAGNETIC CONTROL





Whether used for standby or on-site portable power, electric plant breakdowns can be critical. That's why Onan is beefed up with bigger bearings, shorter-stronger connecting rods and crankshafts, and Stellite valves. *Only Onan is Performance Certified* to deliver every watt of power promised by the nameplate rating.

# Only Onan is certified to give you all the power promised by its nameplate

It's a fact that many electric plants on the market today do not deliver the output promised by their nameplate rating.

Every Onan plant is given a rugged workout *under full load* before it is shipped—*your assurance* that the Onan you buy is ready for hard work the day you get it.

But this isn't enough. Independent laboratory inspectors pull surprise inspections to double-check our tests and testing methods. They pull a plant off the line, run it, stop it, load it, overload it, check and recheck. Their torture test gives positive proof of Onan's quality. End result: *Onan's exclusive Per-*

*formance Certification . . . your assurance of getting every watt of power you pay for.*

So when you're tempted by an electric plant "bargain," make sure its nameplate rating is not "inflated." Be sure you're getting full measure for your money. Remember, *the electric plant that short-changes you in power output is no bargain at any price!* Only Onan is Performance Certified to deliver everything the nameplate promises.

See Onan electric plants soon. Compare before you buy. You'll find your Onan distributor listed in the Yellow Pages. Call him or write direct.



**World's Leading Builder of Electric Power Plants**

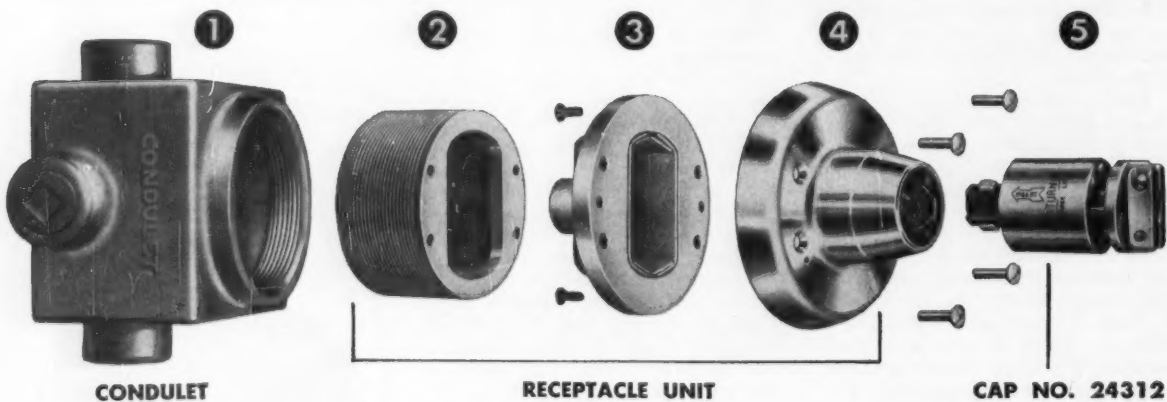
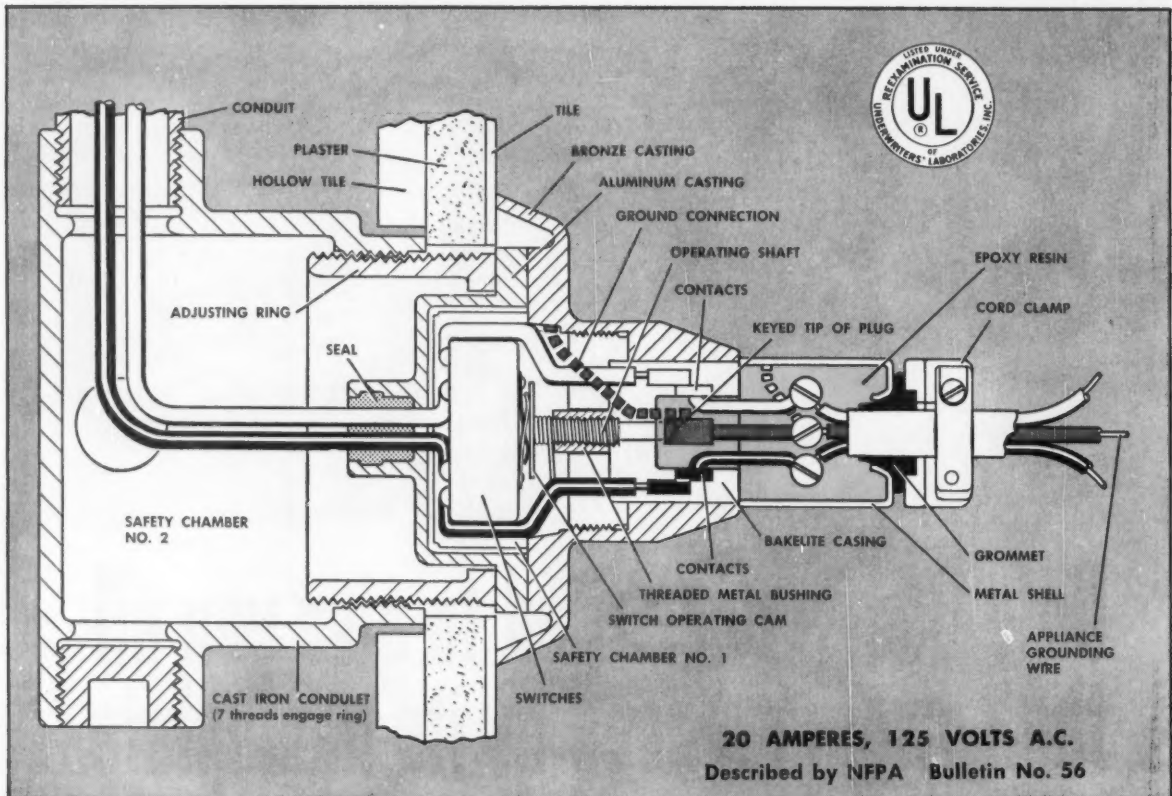


**ONAN** Division, Studebaker-Packard Corporation, 2529 University Ave. S. E., Minneapolis 14, Minn.



# EXPLOSION

## OUTLET AND PLUG PREVENT ARCING



Write for complete information.

Complete explosion-proof unit consists of: (1) No. 24305 shallow or No. 24306 deep cast iron Condulet box. (2) Threaded cast iron adjusting ring for 0" to 5/8" or for 0" to 1 1/4" adjustment. (3) Cast aluminum safety chamber. (4)

Polished chrome-finish bronze casting containing specially keyed "Hubbellock" Explosion-Proof Receptacle. (5) Specially keyed "Hubbellock" Explosion-Proof Cap No. 24312, which is washable, vapor-proof, and waterproof.



# - PROOF

## IN HAZARDOUS ATMOSPHERES

### New Safety for Hospital Operating Rooms and Class I, Group C or D, Industrial Atmospheres

Designed to meet the safety specifications of a leading New England hospital, the new "Hubbellock" Explosion-proof Receptacle and Plug cannot arc when circuits are closed or opened.

These devices establish a new standard of electrical safety in hospital operating rooms and in industrial areas where Class I, Group C or D, atmospheres disqualify conventional wiring devices.

#### DUAL SAFETY CHAMBER

Current will not flow until a specially keyed "Hubbellock" plug (No. 24312) is firmly seated and locked by rotating it clockwise. This action causes a cam to operate paired microswitches in a casting-enclosed safety chamber.

This chamber connects with a Crouse-Hinds Type CPS Condulet, which forms a second safety chamber to prevent escape of flame into the operating room if gas should ignite in the switching chamber.

#### VAPOR-PROOF PLUG

Further protection is provided because all air spaces where gases might collect within the plug are filled with a self-hardening epoxy resin, poured in at the time the three-wire cord is fastened to the terminals.

As a result, this vapor-proof plug is also absolutely waterproof. It can be washed without disconnecting it from the cord, so that operating room soilage may be removed without delay.

Strain on the terminals is relieved by rugged cord clamps. A pressure-expanded grommet provides additional sealing.

#### EXTRA SAFETY FEATURE

Because the receptacle is keyed to accept only this special explosion-proof "Hubbellock" plug (No. 24312), accidental insertion of standard "Hubbellock" plugs is prevented.

However, the explosion-proof plug *will* operate in standard "Hubbellock" receptacles, so that explosion-proof surgical or electrical appliances equipped with the explosion-proof plug may be used in non-hazardous locations if necessary.

#### ONE-HAND OPERATION

The receptacle is the dead-front type with a spring-loaded shutter. No covers or other mechanical closures are necessary. This permits one-hand connection or disconnection of appliances, which is a great convenience in operating rooms or other hazardous locations.

The receptacle and plug are UL listed for new installations with the Crouse-Hinds Condulet. For modernizing existing wiring, a special mat is provided, and the installation is subject to approval by local inspectors.

Receptacle and plug are described for use in any Class I, Group C or D, atmosphere by the National Fire Protection Association.

EXPLOSION-PROOF  
**Hubbellock**<sup>®</sup>  
WIRING DEVICES



**HARVEY HUBBELL, INCORPORATED** •  
"HUBBELLOCK" IS A REGISTERED TRADEMARK OF HARVEY HUBBELL, INC.

BRIDGEPORT 2, CONNECTICUT  
IN CANADA: SCARBOROUGH, ONTARIO

# The Future is on our drawing boards and in our conference rooms !

***Curtis-AllBrite announces a 10-year plan  
of product development . . . advanced  
lighting concepts . . . new ideas—new  
answers to illumination problems***

Seldom in American industry does a company offer a blueprint for the future so all-encompassing as the program just announced by Curtis-AllBrite Lighting, Inc.

For the Curtis-AllBrite plan spans a generation and it has an application for the present. So that you may have something truly new, around which to design today, Curtis-AllBrite makes this promise. On January 31, 1961, the wraps will be taken off three inspired design fixtures. These new advances in lighting concepts are: 1. *A more efficient way of lighting industrial plants.* 2. *A means of cutting installation costs of illumination combined with other utilities . . . ideal for office buildings, banks, showrooms, hospitals and schools.* 3. *New slim-line design fixtures to pique your imagination . . . ideal for today's architectural concepts.*


So, look to Curtis-AllBrite for new ideas—new answers in lighting today, tomorrow, and ten years from now. You know you can rely on Curtis-AllBrite where 77 years of experience stand behind every fixture . . . where you can be confident you are associating your name with a company that has over 50 important "firsts" in the science of illumination. These include the development of the concept of concealed lighting, ending the era of the bare lamp on a drop cord and the pioneering of the Alzak process for finishing aluminum reflectors. And you can be sure, too, there will be important improvements in the days to come since the future in lighting is on our drawing boards and in our conference rooms. Curtis-AllBrite Lighting, Inc., 6135 W. 65th Street, Chicago 38, Illinois—San Francisco, California—Toronto, Canada—Vancouver, B.C.

**CURTIS-ALLBRITE**

LIGHTING, INC.

*Visioneers in Planned Lighting*





■ The ultimate in "*Slimplicity*" . . . flowing contours that will be around for years to come. Ideal for the bold, imaginative application.

■ Brings a new dimension to industrial lighting—a forward concept in harmony with today's plant design.

Tomorrow is here . . .  
under wraps...3 truly exciting  
innovations in illumination  
available for you  
January 31, 1961!

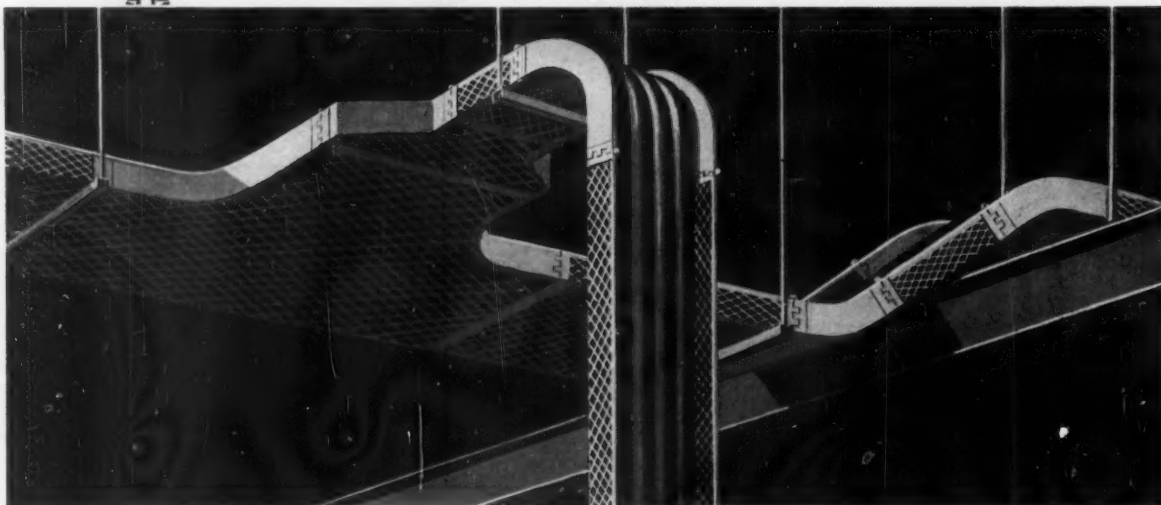
■ The answer to utility yet brimming with beauty . . . a trend fixture with the future designed in.



WHY THIS?



WHY NOT THIS?



## COPE WIREWAY CABLE SUPPORTING SYSTEMS SAVE "3 WAYS" OVER "TRADITIONAL" MATERIALS

Why pay a premium for your cable supporting equipment—when Cope Wireway offers a *completely integrated system* for much less. Compare these facts for yourself.

- **Lower material cost—**

One section of 24" wide Wireway supports *as many cables* as 16 lengths of 4" conduit—at only 1/10th the weight. That means you're buying much less materials regardless of the size of the job.

- **Less to install—**

Wireway's lightweight and unique coupling method, speeds joining of straight lengths and fittings—even in close quarters. A Cope system comes *complete* with all necessary accessories—ready to go.

- **Built-in expansibility—**

With Wireway, you need not be concerned about costly re-routing or later additions to your system. Cables are always readily accessible and Cope's pin type couplers can be quickly disconnected to permit change in direction or elevation.

Ask for proof! See your authorized Cope Electrical Wholesaler for more information on economical Cope Wireway—in either aluminum or hot dipped galvanized steel. Or write us direct.

1102

# COPE

Originators of the first integrated line of  
Cable Supporting Systems

• WIREWAY • CHANNEL • LADDER • CONTROLWAY

Sold only through authorized electrical wholesalers

DIVISION OF ROME CABLE CORPORATION • COLLEGEVILLE, PENNSYLVANIA

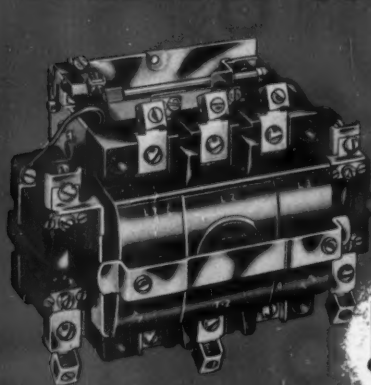


# ANNOUNCING

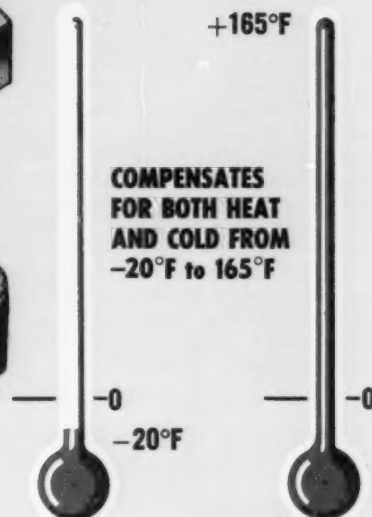
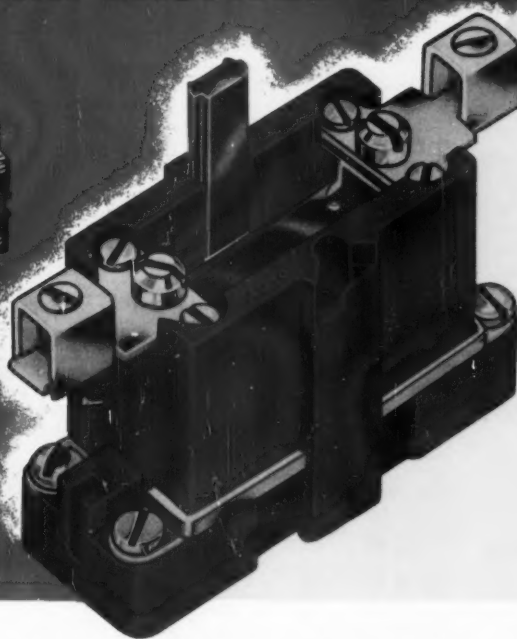
Something **NEW** under the sun

the **ARROW** **AH** **HART**

## AMBIENT COMPENSATED OVERLOAD RELAY



FOR ALL  
ARROW-HART  
MAGNETIC  
STARTERS...  
NEMA SIZES  
0 THROUGH 51



### RELIABLE AND ACCURATE PROTECTION REGARDLESS OF HEAT OR COLD

Here, for the first time, is a compact overload relay that compensates for both heat and cold, operating on the same time curve at all temperatures from  $-20^{\circ}\text{F}$  to  $165^{\circ}\text{F}$ . Compensation is completely automatic. No field adjustment is needed. Operating mechanism is simple, rugged and dependable.

This performance is made possible by the exclusive Arrow-Hart "Balancing Bi-Metal" which is located in a separate compartment and is not, therefore, affected by heat applied to the working bi-metal.

- MUCH SMALLER SIZE . . . than any other comparable unit now available. Base size is the same as standard A-H Overload Relays.
- USES STANDARD HEATERS . . . and works equally well with either quick-trip or regular type.
- COMPENSATES AUTOMATICALLY for both heat or cold, by means of an exclusive, "Balancing Bi-Metal"

Effective through a temperature range from  $-20^{\circ}\text{F}$  to  $165^{\circ}\text{F}$ .

• **DEPENDABLE IN OPERATION** . . . and requires no adjustments of any kind.

• **AVAILABLE** . . . with all A-H Starters. Ratings from 25 to 300 amperes, continuous current. Normally supplied with manual reset. If desired, relays can be equipped with a change-over lever that provides manual or automatic reset, as required.

### IDEAL FOR USE . . .

**OUTDOORS** . . . in oil fields and other installations subjected to wide seasonal or daily changes in ambient temperatures.

**INDOORS** . . . for control installations located near boilers, furnaces, heating units or refrigeration equipment and subjected to wide daily changes in ambient temperature.

SEE NEXT PAGE FOR CONSTRUCTION DETAILS and ADDITIONAL DATA . . .

THE ARROW-HART & HEGEMAN ELECTRIC CO., HARTFORD 6, CONNECTICUT



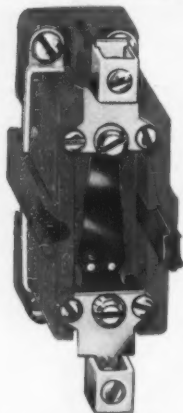
# AMBIENT COMPENSATED OVERLOAD RELAYS WITH "BALANCING BI-METAL"

**DEPENDABLE, AUTOMATIC COMPENSATION for  
A WIDE RANGE OF TEMPERATURE CHANGES**

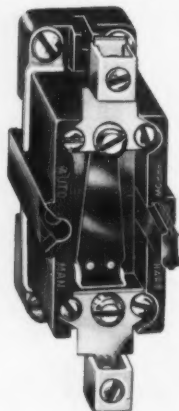
As shown in the accompanying drawing, the working bi-metal and the compensating bi-metal are identical in size and construction and are joined by a coupling bar. As the ambient temperature rises above 72°F, the compensating bi-metal operates through the coupling bar to move the working bi-metal in order to maintain its distance from the trip arm. Similarly, as the ambient temperature falls below 72°F, the compensating bi-metal operates to maintain its distance from the trip arm. Therefore, tripping time remains the same regardless of temperature. Switching mechanism itself employs the same positive snap-action featured in all Arrow-Hart Overload Relays. The calibrating screw permits precise setting. This screw is set and sealed at the factory and requires no further adjustment.

SEND NOW FOR COMPLETE INFORMATION

**COMPARABLE IN SIZE TO  
STANDARD ARROW-HART O.L. RELAYS**



**New  
Ambient Compensated  
O.L. Relay**



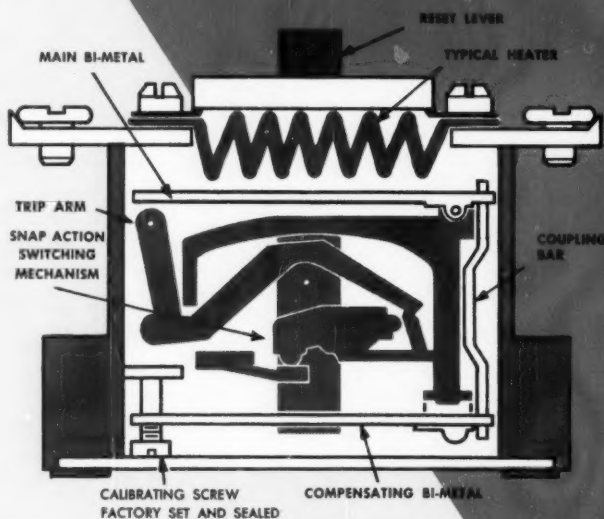
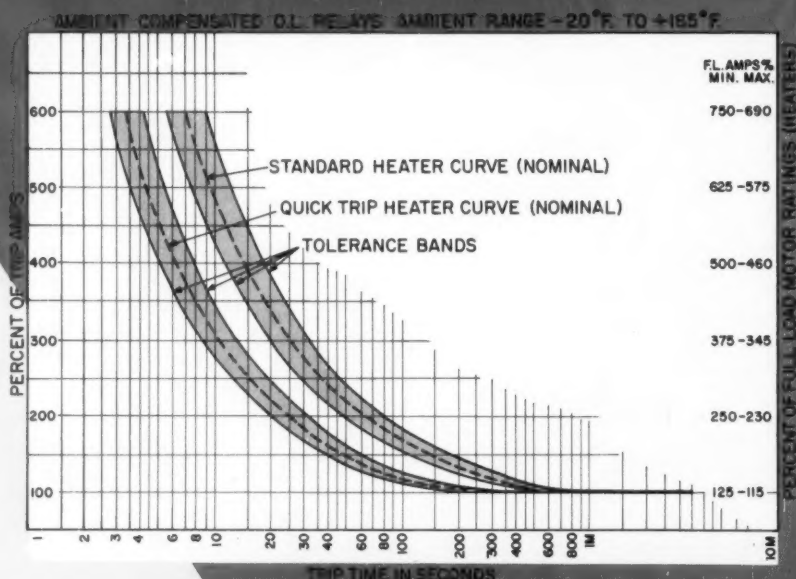
**Standard  
O.L. Relay**

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY  
103 Hawthorn Street, Hartford 6, Connecticut  
MOTOR CONTROL DIVISION

Please send me complete information on the new Arrow-Hart Ambient Compensated Overload Relays with exclusive "Balancing Bi-Metal" Mechanism.

name \_\_\_\_\_  
position \_\_\_\_\_  
company \_\_\_\_\_  
co. address \_\_\_\_\_  
city \_\_\_\_\_ zone \_\_\_\_\_ state \_\_\_\_\_

ECM



PATENT NO. 2,908,786

**OPERATES ON THE SAME TIME CURVE AT ALL  
TEMPERATURES FROM -20°F TO 165°F**

**ARROW AH HART**  
*Quality since 1890*

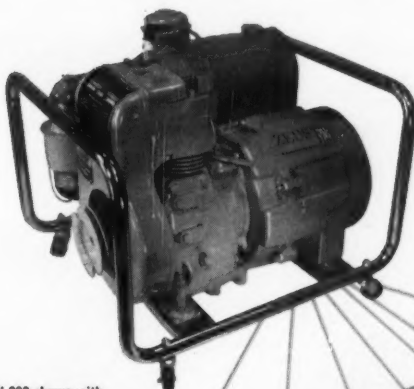
MOTOR CONTROLS • ENCLOSED SWITCHES  
APPLIANCE SWITCHES • WIRING DEVICES

# INSTANT POWER

anyplace...anytime  
with a

# ZEUS

## PORTABLE ELECTRIC GENERATOR



Model GW-300 shown with  
optional casters, frame and fuel tank.

\*The Permanent Magnet Alternator eliminates  
brushes, commutators, and slip rings  
... minimizes maintenance.

It's here! The new 3000-watt Zeus Portable Electric Generator now provides contractors everywhere with a *reliable* source of AC power . . . eliminates costly power-line installations . . . *pays for itself!* The job-proven Zeus features three fused outlets (115v & 230v) . . . dependable direct-drive gas engine . . . plus the exclusive Borg-Warner PMA\* generator that *never wears out!* Lightweight Zeus generators deliver continuous full voltage for hours without overheating!

Also available in 1250-watt models, Zeus units provide low-cost portable power at any construction site. Send the coupon below today for complete information.



9009-PC



another product of  
**BORG-WARNER CORPORATION**  
Pesco Products Division

EXPORT SALES: Borg-Warner International Corporation • 36 South Wabash Avenue • Chicago 3, Illinois

PESCO PRODUCTS DIVISION • BORG-WARNER CORPORATION  
24700 North Miles Road • Bedford, Ohio Dept. ECM-1

Please send me complete information about the following Zeus  
Portable Electric Generators ☐ 3000-watts ☐ 1250-watts.

NAME \_\_\_\_\_ TITLE \_\_\_\_\_

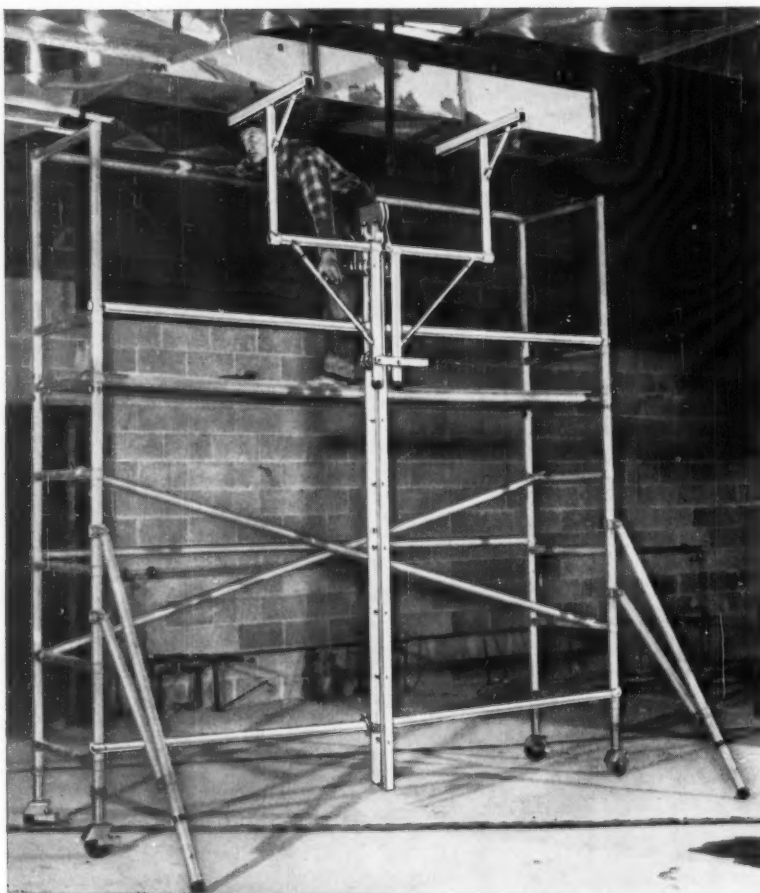
COMPANY \_\_\_\_\_

STREET \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

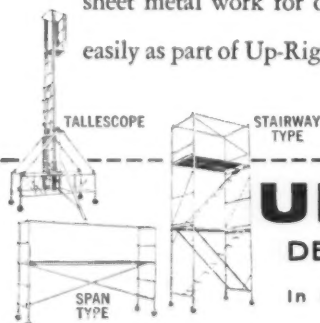
*Double your workman's production...*

## **UP-RIGHT mechanical man lifts & positions material for fast, one-man installation**



Workman and mechanical man accurately position 9 ft. long air duct for easy, rapid installation.

*Mechanical man* is an aluminum hoist assembly instantly attachable to any Up-Right or other scaffold. It saves fatigue and manhours in positioning fluorescent fixtures, bus-ducts, conduit, pipe and sheet metal work for overhead installation at any height. Rolled easily as part of Up-Right aluminum scaffold.

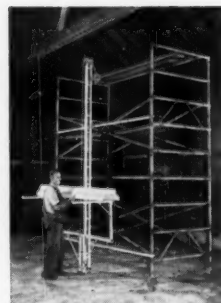
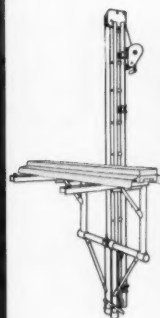


*Write for descriptive circular*

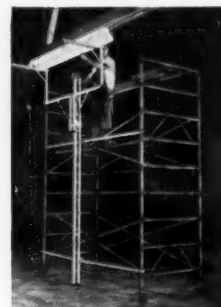
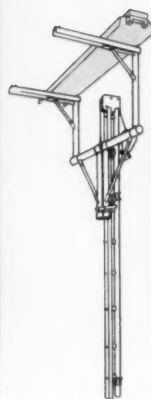
## **UP-RIGHT SCAFFOLDS**

DEPT. 177 1013 PARDEE, BERKELEY, CALIFORNIA

In Canada: Up-Right Scaffolds Ltd., 120 Russet Ave., Oshawa, Ontario



Fixture is placed on lifting arms at convenient chest height.



Fixture is elevated along vertical track by winch.



Lifting arms move horizontally on rollers and elevate fixture to desired position above workman for fast, convenient installation.





*2' x 2' control lenses of PLEXIGLAS mounted in pairs, County of Sonoma office building, office of Superintendent of Schools, Santa Rosa, California • Architects: Steel & Van Dyke, Santa Rosa*

## Plexiglas...for lighting that stands out and stands up

"Illumination of the highest quality." This is the phrase that describes installations of lighting equipment which includes control lenses molded of PLEXIGLAS® acrylic plastic.

Lenses of PLEXIGLAS provide freedom from glare at any normal viewing angle, because they are precisely designed optical elements that "bend" light rays. And the crystal clarity of PLEXIGLAS assures full utilization of light, with complete visual comfort.

In addition, PLEXIGLAS lenses remain free of discoloration even after years of exposure to fluorescent light. They are strong and rigid yet light in weight, resulting in safety overhead and ease of maintenance.

We will be pleased to send you the names of equipment manufacturers who use PLEXIGLAS lenses, and a copy of our bulletin "PLEXIGLAS for Lighting," which contains full details on the use of this quality lighting material.



*In Canada: Rohm & Haas Co. of Canada, Ltd., West Hill, Ontario*

# PLEXIGLAS



# Only **C-L-X<sup>®</sup>** Continuous Lightweight Exterior **Sealed Cable Systems** by **Simplex** **Can do so Many Jobs** **so Well**

Simplex C-L-X is a packaged combination of cable and an extremely pliable, corrugated metal sheath. It requires no separate duct or conduit regardless of environment. It is available with steel sheath and plastic jacketing; and with copper or aluminum sheaths, with or without plastic jacketing.

## *C-L-X Cuts Installation Costs*

By using a single length of 3-conductor 15KV C-L-X for both underground and aerial use, a Southeastern utility company saved more than 20,000 dollars from what it would have cost for a complete underground duct system.

## *Resists Chemical Attack*

Conduit life in this company's calcium chloride reclamation building was only 6 to 9 months. The conduit was replaced with a C-L-X cable system which — after two years of operation, shows no signs of deterioration.

## *Protects Against Liquids and Gases*

An East Coast petroleum tank farm used a C-L-X 8-conductor cable protected with PVC for direct burial in ground that was saturated with oil, gas and water. Result: Perfect performance at a sizeable savings over conduit systems.

Only Simplex C-L-X offers you: Exceptional Strength . . . Unequalled Pliability . . . Protection from Liquids and Gases . . . Faster Installation and Lower Costs. Send for Illustrated Brochure containing Application and Engineering Data.

# SIMPLEX WIRE & CABLE CO

CAMBRIDGE, MASSACHUSETTS

**INTRODUCING**.....

a major advancement in  
grouped motor control

# NEW GENERAL ELECTRIC CONTROL CENTER

**14**

new features for  
**TOP PROTECTION OF  
PEOPLE, EQUIPMENT**  
including ...

**12**

new features for  
**FAST AND EASY  
FIELD INSTALLATION**  
including ...

**10**

new features for  
**SIMPLE INSPECTION  
AND MAINTENANCE**  
including ...



**INTRODUCING...**



# ADVANCED-DE CONTROL CEN

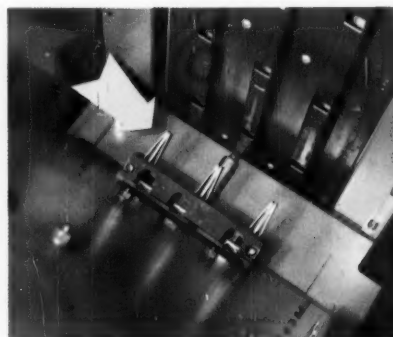
**14**

**new features for  
TOP PROTECTION OF  
PEOPLE, EQUIPMENT**

**including ...**



**POLYESTER "SANDWICH"** isolates, insulates vertical bus — blocks spread of fault from starter to vertical or horizontal bus; guards personnel from accidental bus contact.



**WEDGE-LIKE UNIT TABS** — under double-spring pressure—engage vertical bus, provide positive contact; expand under short circuit stress to prevent "pop out" during fault.



**POSITIVE UNIT** starter unit and gives smooth movement of stabs

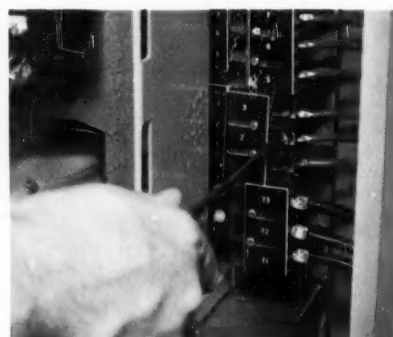
**12**

**new features for  
FAST AND EASY  
FIELD INSTALLATION**

**including ...**



**ISOLATED WIRE TROUGH** provides roomy area to "lay in" wire and make control and load connections. Separate full-height door makes wiring installation and inspection easy.



**CONVENIENT TYPE B TERMINAL BLOCK**—fixed half in wiring trough—is accessible with unit in or out. Sliding coded cover insulators prevent accidental contact with terminals.

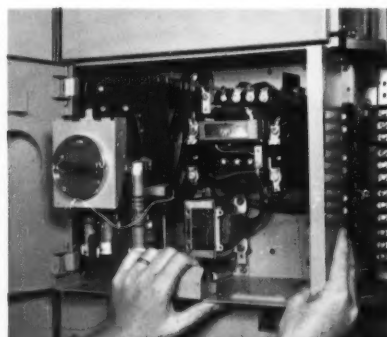


**INCOMING LINE** be located at line cable terminal and looping

**10**

**new features for  
SIMPLE INSPECTION  
AND MAINTENANCE**

**including ...**



**DRAWOUT CONNECTIONS** permit starter unit removal or insertion without disturbing load or control wiring; allow inspection of individual starters without complete shutdown.



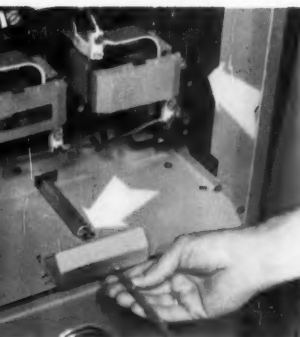
**UNIQUE SLIDING COVERS** close to form effective isolation barrier ... open easily to permit front inspection and maintenance of the vertical and horizontal bus connections.



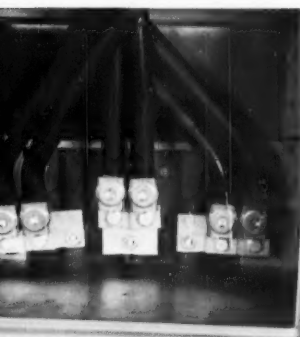
**ROTARY HANDLE** breaker or fuse unit; gives positive device position



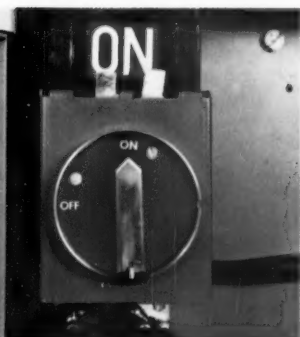
# DESIGN CENTER



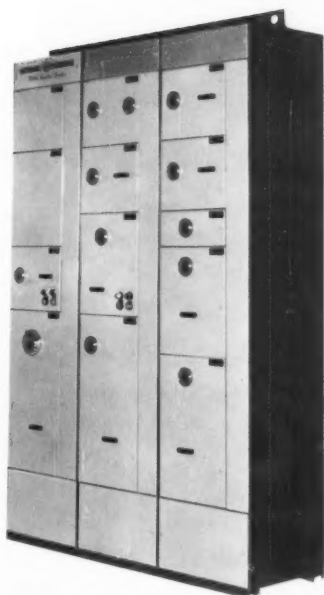
**UNIT GUIDANCE SYSTEM**—slot on unit and matching track on barrier—smooth travel of unit, positive alignment, stabs and drawout "B" block.



**LINE TERMINAL** compartment can be used at top or bottom, allows straight-line terminations—eliminates bend-looping of heavy cables.



**HANDLE MECHANISM**—for circuit or fused switch—is mounted on positive interlock; clearly shows position; locks "ON" or "OFF."



## CONTROL CENTER

... all-new grouped control for independent or coordinated units

Now . . . from General Electric comes the all-new, *advanced-design* Control Center. Combined in this center are more than 40 new features that add up to outstanding performance in equipment protection, personnel safety, and ease of installation and maintenance.

This centralized control for a-c and d-c motors also provides interlocking and sequencing of motor operation and over-current protection of feeder and branch circuits—including lighting. The *advanced-design* Control Center—with short circuit interrupting capacity up to 100,000 amperes—will handle: (1) motor starters to NEMA Size 6; (2) feeder circuits to 800 amperes; and, (3) power concentrations to 1200 amperes.

The building-block, modular construction of the General Electric Control Center adapts quickly to a variety of layouts to fit available space . . . permits optimum arrangement of starter units within each section to meet any application. This flexibility of design makes allowance for future expansion or modification to meet changing requirements . . . without costly downtime or major added investment.

For complete information on *advanced-design* General Electric Control Center, contact your General Electric Sales Representative or Distributor. Or, write General Electric Co., Schenectady 5, N. Y. *Industry Control Dept.*, Salem, Va.; *Distribution Assemblies Dept.*, Plainville, Conn. 783-17

GENERAL  ELECTRIC

For over fifty years, McGill's insistence on superior design and craftsmanship, scientific testing technique, and quality materials has meant *dependability* to users of electrical specialties. McGill continues to serve the changing needs of industry —with quality products such as these . . .

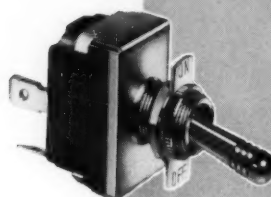
**SPECIFY  
MCGILL®  
BETTER-BUILT  
LONGER-LASTING**



**UNCONDITIONALLY GUARANTEED  
NO. 41 LEVOLIER® SWITCHES**

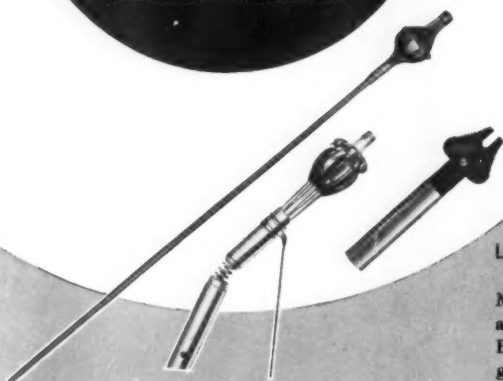
McGill makes the only switch of its kind with an unconditional guarantee against failure in lighting circuits. The Levolver Switch is available for many lighting and power applications, in single-pole, single and two-circuit models with pull-chain, lever and push-button operations. From 3 to 20-amp. Underwriters Laboratories, Inc. inspected.

**QUALITY *Levolver®* SWITCHES**



**NEW DP MODEL LEVOLIER®  
TOGGLE SWITCHES**

You can depend on McGill Toggle Switches for precision operation of motors, power tools, control panels, and countless other applications. Choose from a long line of SP and DP, two-circuit and three-way models. Choice of terminals, lever colors, circuitry arrangements. 6 to 20 amps. Underwriters Laboratories Inc. inspected.



**LAMP CHANGERS — BROKEN LAMP BASE REMOVER**

McGill lamp changers make lamp changing safe and easy. Available in a variety of heads for lamp bulbs of any size or shape. Broken lamp base remover avoids danger from shock or broken glass. Insulated poles, with or without angle adjustment, fit lamp changer or broken lamp base remover heads.

**...AND PORTABLE LAMP GUARDS**



**NO. 5000-SLRG. GROUNDED GUARD**

- Non-conductive molded phenolic handle
- 3-wire convenience outlet
- 2 cage designs



Write for full information. McGill catalog 84 will provide you with full details and specifications for these and many other electrical specialties by McGill.



**3000 SERIES VAPORPROOF GUARDS**

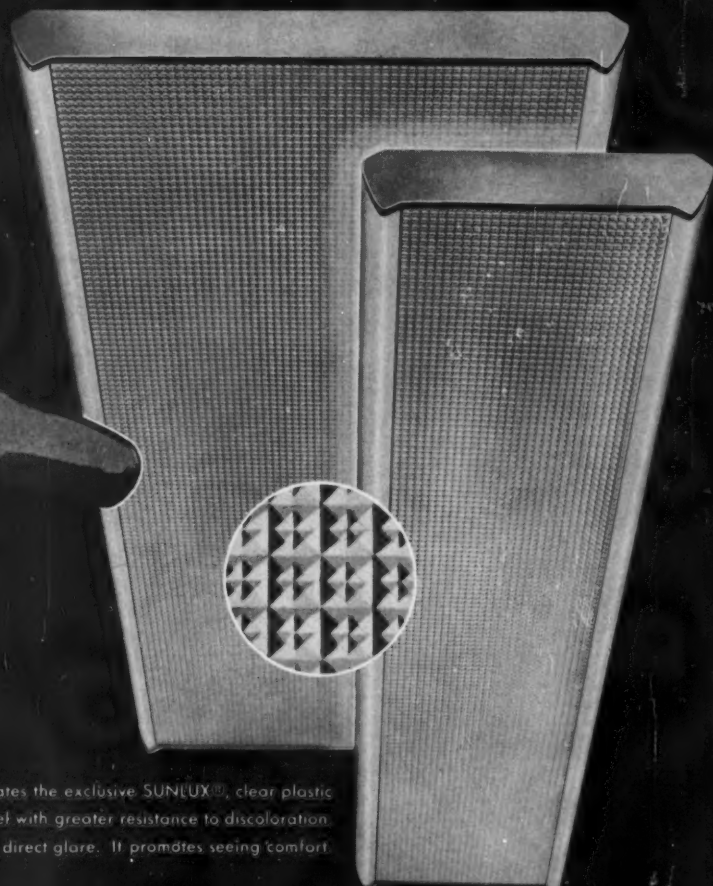
- Watertight, dust-tight, moisture-proof
- Fiber, steel, copper cages

engineered electrical products

**MCGILL®**  
precision needle roller bearings

MCGILL MANUFACTURING COMPANY, INC., ELECTRICAL DIV., 450 N. CAMPBELL ST., VALPARAISO, INDIANA

# THEY'RE ALL POINTING TO QPCX7400\*



QPCX7400 incorporates the exclusive SUNLUX®, clear plastic lens panel with greater resistance to discoloration. SUNLUX® reduces direct glare. It promotes seeing comfort.

\*QPCX7400 is an ultra-shallow, surface-mounted Visionaire® lighting fixture to which they are all pointing.

**Architects** are pointing to it in their specifications because they like its modern, wafer-thin appearance and the way it "blends" with the ceiling.

**Engineers** are pointing to it because of its efficient, high quality illumination with excellent diffusion and low brightness control.

**Electrical contractors** point to its rugged features

for speedy installation. And — the **building owner**, rightfully demanding full value on his investment, points with pride to QPCX7400 because he knows he's getting a lighting system engineered for long life and minimum maintenance. He's satisfied too, that the price is right and that future alterations can be accomplished economically.



Write for bulletin A841

**SUNBEAM LIGHTING COMPANY**

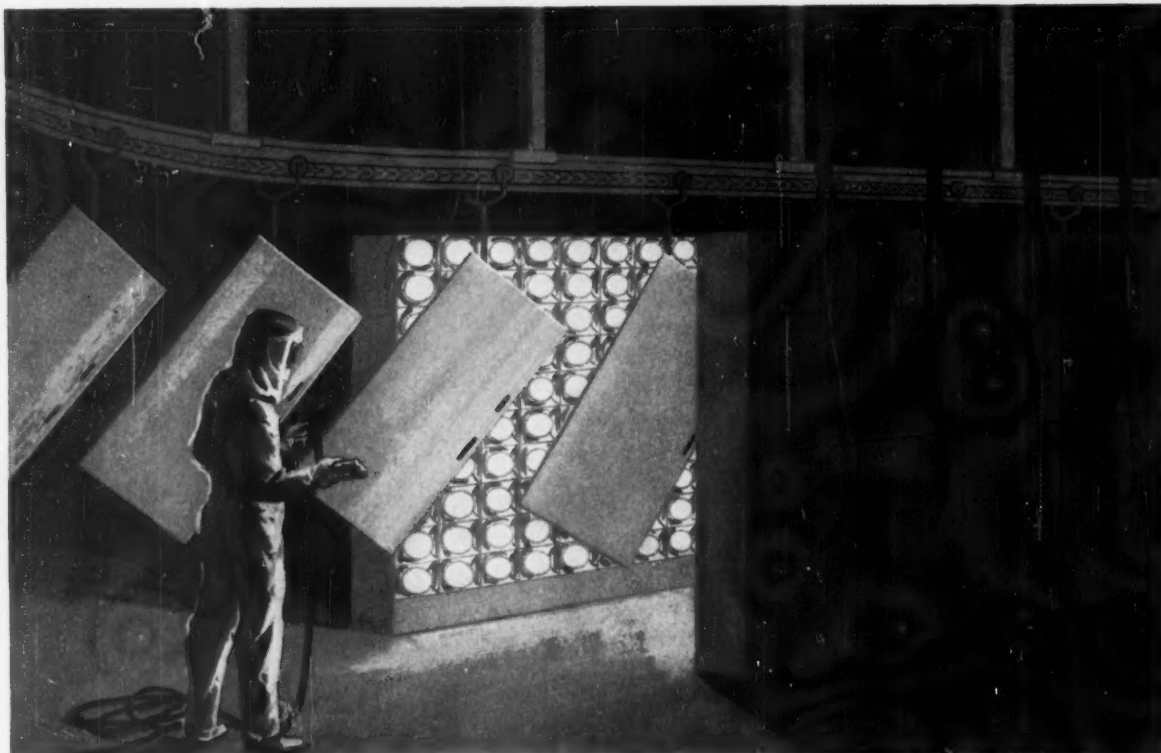
777 E. 14th Pl., Los Angeles, Calif.  
3840 Georgia Street, Gary, Indiana



Patents Pending



# Use This Cable Plant-Wide



## Silastic Insulation Withstands the Rigors of Heat, Cold and Weathering

You can eliminate the extra expense of stocking many specialty wires and cables. How? By specifying Silastic®, the Dow Corning silicone rubber.

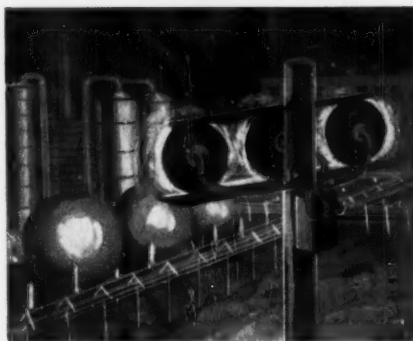
Silastic is more than a match for many of your plant's toughest service conditions. First of all, you can count on Silastic to give reliable service in or near ovens, boilers, fans, blowers and other "hot" applications where temperatures go up to 260 C. This cable covering resists the torture of high temperature aging, overloads or sudden power surges. Stays rubbery . . . it won't crack to allow electrical failure. And there's no brittleness even at -90 C . . . so you can flex Silastic insulated cable in bitter cold, too.

What's more, this versatile wire and cable insulation resists year 'round outdoor weathering . . . won't harden, crack or check. At a south Florida test station, Silastic samples showed no signs of weather deterioration after more than 9 years of continuous exposure.

Leading manufacturers now offer power cable, control cable, hookup wire, fixture wire and building wire with insulation of Silastic.

### TYPICAL PROPERTIES OF SILASTIC FOR WIRE

Temperature range, °F	-----	-130 to 500
Insulation resistance, megohms/1000 ft.	-----	1000 to 3000
Electric strength, volts/mil	-----	300 to 500
Dielectric constant, 10 <sup>3</sup> cycles per second, nominal	-----	3.2



For new booklet on how to save with Silastic insulated wire and cable and list of suppliers, please address Dept. 2813.

first in  
silicones

**Dow Corning CORPORATION**  
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.



*on your  
next bill  
of materials—*

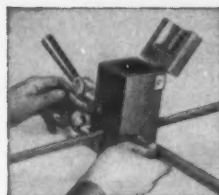
*see your*

**BURNDY  
DISTRIBUTOR**

*for all  
of these  
connections  
made  
with*

# thermOweld®

*welds a permanent  
electrical connection  
easily and economically  
to any copper conductor  
or steel structure*



Weld anywhere with light-weight THERMOWELD. Self-contained, needs no external source of power.



Pour powder into mold, tap. Starting powder won't mix with welding powder, assures positive firing.



Close cover, ignite with flint gun. THERMOWELD forms liquid copper which fuses conductors into solid mass.

# BURNDY

NORWALK, CONNECT. • BICC-BURNDY Ltd., Prescott, Lancs., England • In Continental Europe: Antwerp, Belgium • TORONTO, CANADA

Type CC2

Type CC1

Type CC4

Type CR1

Type CS3

Type CS1

Type CR2

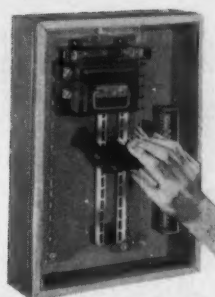
Type CB1

Type BB1

Type BB3



*You can almost see the inspector smile!*



**WHY THE INSPECTOR SMILES:** Here for the first time is complete NON-INTERCHANGEABILITY in fusible service equipment that will pass the most rigid inspection. (As you know, effective January 1, 1961 the National Electrical Code requires the use of type S fuses only!)

**CONTRACTORS SAVE MONEY ON EVERY CIRCUIT:** Compliance with the code normally requires the additional expense of buying and installing fuse adaptors. With Federal Pacific's new 301PS15 and 301PS30 Stab-in fuse blocks you *subtract* these costly extras from every circuit installed because the 301PS enables you to install non-interchangeable type S fuses *without* adaptors.

**AND THIS IS NO FOOLING, EITHER!** All Type SF fusible service equipment is absolutely fool-proof! An exclusive locking clip, supplied on all SF Stab-in units, makes it impossible to remove the unit once it is installed, except with a tool available only to qualified electricians. What's more, there's no fuse shell in the 301PS, so it's impossible to jump the fuse holder with a penny or washer. A request for Bulletin FB-1-1110 will bring you complete information on how you can comply with the code, speed inspection approval and increase your profits. Federal Pacific Electric Company, 50 Paris St., Newark 1, N. J.

FEDERAL PACIFIC ELECTRIC COMPANY



*growth through creative energy*

# ALLIS-CHALMERS



## NEW SPACE MAKER

drawout motor controller  
...2000 to 5000 v



so low...



TWO  
FIT where one  
used to go

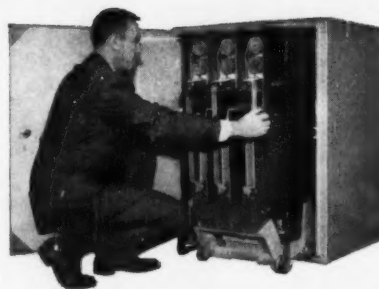
New *SpaceMaker* control is the first completely new high-voltage motor controller in more than a decade. It is the first two-high, 2 to 5 kv control center, and the first in its voltage class with complete drawout construction for unprecedented safety and accessibility.

Inspection and maintenance are greatly simplified. One man can easily roll the carriage from the control enclosure for complete accessibility. Arc chutes and barriers lift out and the pole pieces rotate

to expose the contact structure.

And, *SpaceMaker* control is completely safe. It is impossible to come in contact with "live" parts because the contactor is connected and disconnected with the door closed and live line connections are isolated by automatic shutters.

For complete details of the new, years-ahead *SpaceMaker* controller, call your nearby A-C representative. Or write **Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.** A-1406



*SpaceMaker* is an Allis-Chalmers trademark.



# EASIEST TO USE BUILT-IN WRENCH EASIEST TO USE BUILT-IN WRENCH EASIEST TO USE BUILT-IN WRENCH **WING-NUT**



**easiest to use --  
built-in wrench**



If you can twist your wrist you can make a perfect splice with a Wing-Nut. You don't need tools — even on the toughest branch circuit wires, like stiff vinyl insulated #6.

Unique wings provide a natural grip. Because of the mechanical leverage gained by this "built-in" wrench, plus the expanding spring action, the Wing-Nut takes only about half as much the turning force to apply as other connectors. Once made, this joint will never come loose because of the tremendous spring-tension holding the wires. The only way it will come off is for you to remove it from the joint.

Further, you don't have to depend merely on the feel of the joint to know that you have a good connection. You can actually see it through the semi-transparent Nylon shell, the strongest used on any connector. And the Wing-Nut skirt is so wide and

deep that it slips easily over a wire combination as large as two No. 8 and a No. 6, even thick type RW insulated wire. In crowded boxes just clip the wings off after applying.

Safe, you bet it is! Wing-Nut has unqualified listing as a pressure cable and fixture splicing connector for 474 combinations of solid and stranded copper wire. Plus many aluminum-to-aluminum combinations, from No. 12 to No. 6 gauge wire.

Honestly, until you twist on Wing-Nuts, you've never made splices so good, so easily. See for yourself. Buy a supply or **SEND FOR FREE SAMPLES.**

*Sold through America's Leading Distributors  
In Canada: Irving Smith, Ltd., Montreal*

**IDEAL INDUSTRIES, Inc.,**  
5224-A Park Avenue, Sycamore, Illinois

STEEL CITY'S

# ADJUSTABLE BAR HANGERS

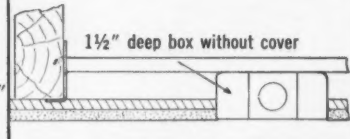
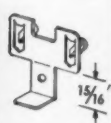
Three different depths of footed end plates for automatic positioning fits the hanger to the job with assembly line speed—fastens securely without nails



With die-cast stud or box fastener

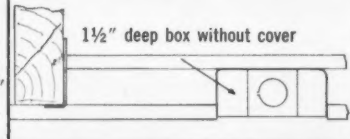
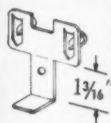
1

$\frac{1}{2}$ ",  $\frac{3}{4}$ ",  $\frac{7}{8}$ "  
**PLASTER**



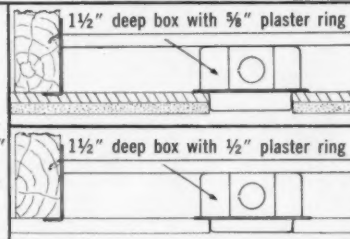
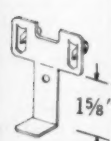
2

$\frac{3}{8}$ ",  $\frac{1}{2}$ ",  $\frac{5}{8}$ "  
**DRY WALL BOARD**



3

**PLASTER  
OR  
DRY WALL BOARD**



Two Sizes  
Adjustable: 11 1/2" to 18 1/2"  
18 1/2" to 26 1/2"

Bar and Box Assemblies available for conduit,  
armored and non-metallic sheathed cables

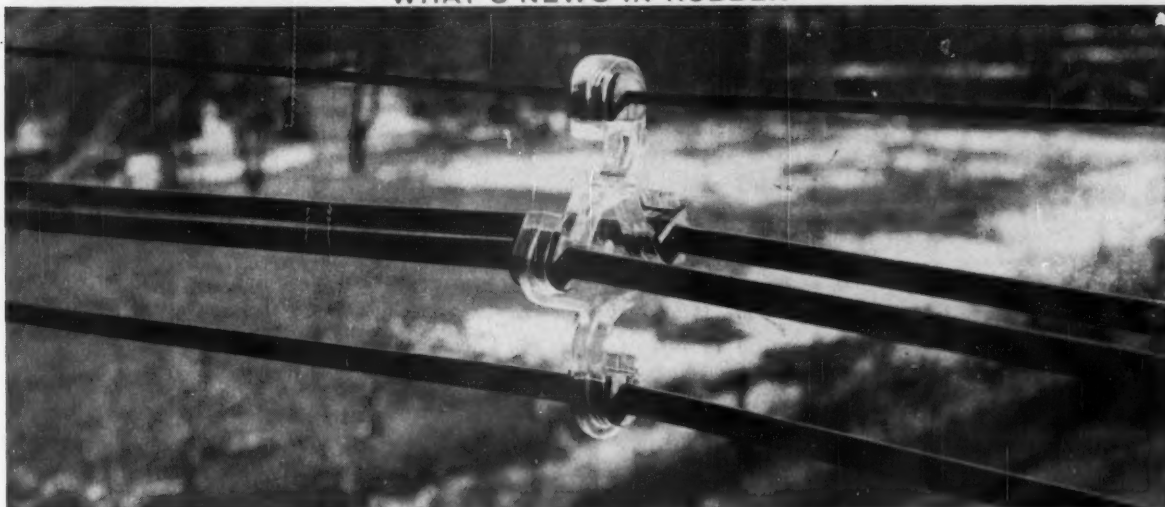
Electrogalvanized



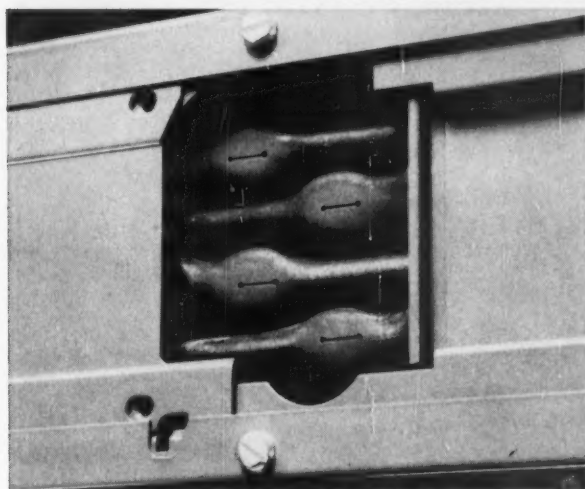
Write for Bulletin BH-5

**STEEL CITY  
ELECTRIC COMPANY**

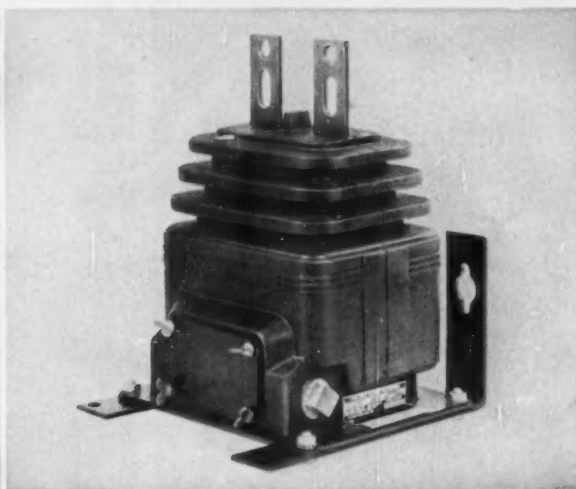
Subsidiary of American-Marietta Co.  
**PITTSBURGH 33, PENNA.**



Butyl rubber insulates modern high-voltage transmission lines.



Butyl rubber insulates modern bus duct systems.



Butyl rubber insulates modern high-voltage transformers.

# ENJAY BUTYL

best way to handle electricity

Enjay Butyl tops all vulcanizable rubbers in electrical and dielectric properties . . . in resistance to corona and ozone breakdown and water absorption. Its high dielectric strength insures against electric breakdown under normal or surge voltage. Its heat resistance permits higher current flow for a given conductor size. Butyl also offers outstanding resist-

ance to weathering and sunlight . . . chemicals . . . abrasion, tear and flexing . . . superior damping properties . . . unmatched impermeability to gases. Result? Butyl is ideal for wire and power cable, transformers, tapes, bus bars, and other insulation applications.

Find out how this versatile rubber can improve your product. Contact the nearest Enjay office. *Home Office:* 15

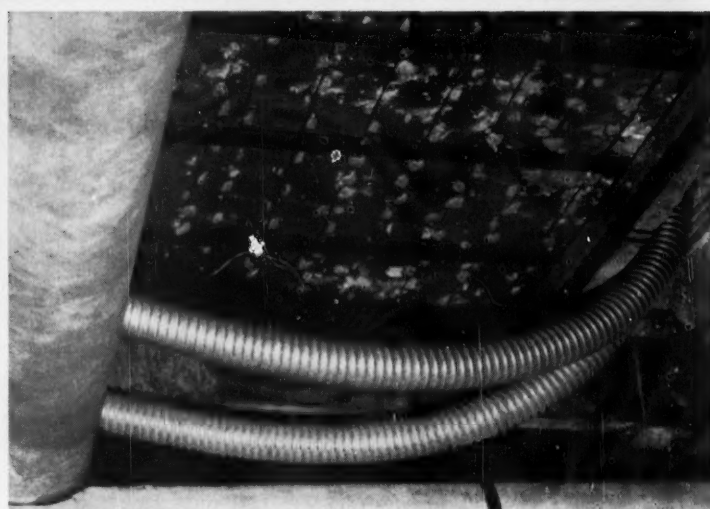
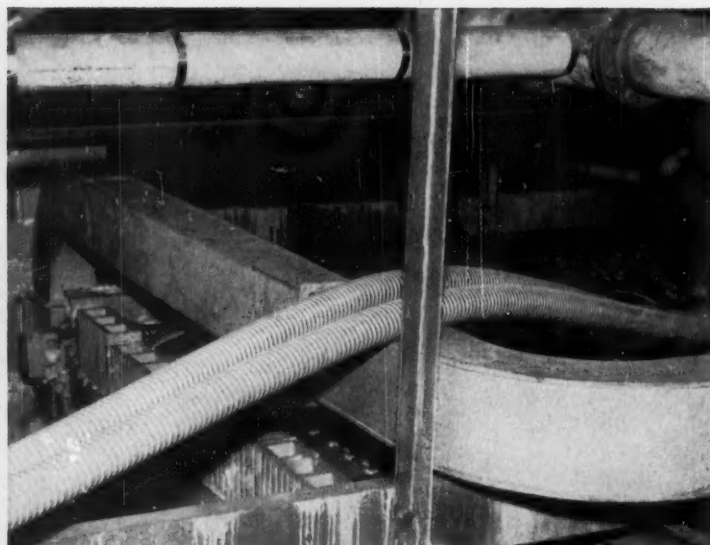
West 51st Street, New York 19, N.Y. *Other Offices:* Akron • Boston • Charlotte • Chicago • Houston • Los Angeles • New Orleans • Plainfield, N. J. • Southfield, Mich. • Tulsa

EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

**ENJAY CHEMICAL COMPANY**

A DIVISION OF HUMBLE OIL & REFINING COMPANY





**For air conditioning:** Three conductor, 500 Mcm, 37 wire,  $\frac{3}{4}$ " varnished-cambic insulated Anaconda Duralox Cable was quickly, easily installed in older building to handle new load.

Cable runs from breaker box in west wing (left) through loft of roof (top right) to side wall building and down wall (bottom right) to breaker box on lower floors.

## **PROBLEM: Installing new circuits in old building**

### **SOLUTION: Duralox Interlocked-armor Cable**

**OR: How to do a hard job the easy (and low-cost) way**

Installing new circuits in an old building—whether for air conditioning, as the case here, or for new machinery or new load centers—can be tough and costly. You either have to go around existing obstructions, a laborious job with rigid conduit, or remove them.

The ideal solution is Anaconda Duralox Interlocked-armor Cable.

Because it is flexible, Duralox Cable is quick, economical to install—indoors or out—with simple supporting devices. It trains easily around corners, columns and other obstructions in *long, unbroken runs*. Circuits are easy to relocate . . . always accessible. Duralox's interlocked metal-tape armor affords excellent protection against mechanical damage.

Anaconda Interlocked-armor Cable is available in sizes

No. 6 Awg to 750 Mcm—copper or aluminum conductors—up to 15 Kv. Underwriters' approved for 600 volts and 5000 volts. With rubber, plastic, or varnished-cambic insulation.

**BULLETIN DM 5606** on Anaconda Duralox Cable gives you full information. Write for your copy today. Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

61263

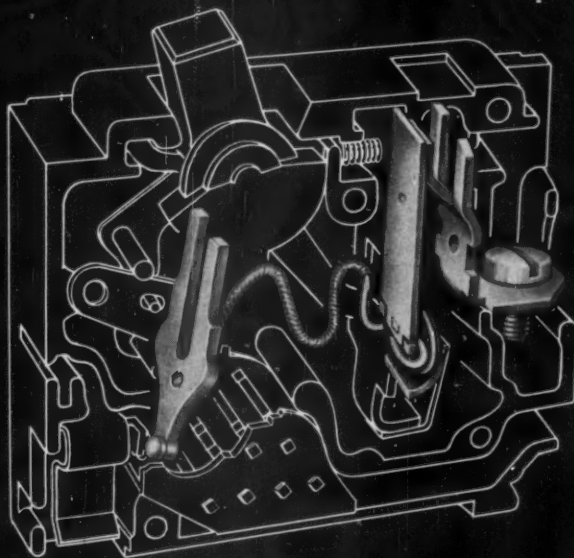
ASK THE MAN FROM  
**ANACONDA**<sup>®</sup>  
FOR INTERLOCKED-ARMOR CABLE





Heat treatment insures  
permanently stable calibration...

## FRANK ADAM CIRCUIT BREAKERS



**FRANK ADAM Quicklag CIRCUIT BREAKERS** provide double protection—thermally against overloads; magnetically against short circuits.

15-amp. and 20-amp. breakers have magnetic coil for lightning-fast trip (not necessary on higher ratings)—elimination of calibration screw prevents tampering—floating armature relieves all pressure on bi-metal element.

Types: QP—Plug-In. QS—Bolt-On. 1, 2 & 3 pole.

Ratings: 15 to 70 amps. Class N1 Non-interchangeable.



*Ambient compensation* in circuit breakers, to prevent nuisance tripping when the temperature goes up or down, is accomplished by the use of bi-metal elements. However, fabricating of these assemblies requires cutting, stamping, forming and welding of the parts which sets up so much internal stress in the bi-metal that it nears its elastic limits.

Unless relieved, these stresses eventually change the shape of the bi-metal pieces thus permanently altering the calibration of the circuit breaker. There is no way to readjust the breaker to its original setting.

Frank Adam insures the stability of vital bi-metal elements in its circuit breakers through a carefully controlled heat-treating process. Unlike most breakers, calibrations in those made by Frank Adam show no discernible variation regardless of temperature changes.

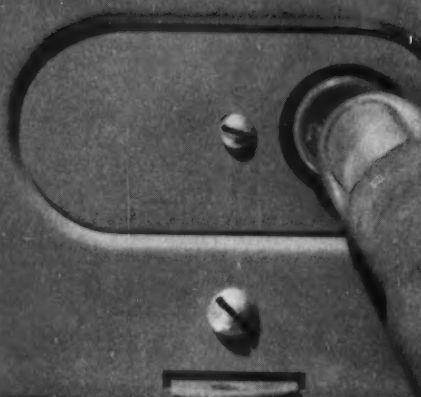
For the industry's most dependable and safest circuit breaker protection, insist on Frank Adam.



SINCE 1891

**FRANK ADAM ELECTRIC COMPANY**  
P. O. BOX 357, MAIN P. O. • ST. LOUIS 66, MO.

busduct • panelboards • switchboards • service equipment  
safety switches • load centers • Quikheler



**Smaller!** About 20% smaller than Size O-Starters. Just 5 3/4" wide, 7" high and 4 3/16" deep.



**Convertible!** Carried in stock with three cover options or easily converted in field from "reset" only to "start and stop-reset" or "three-position selector switch." Kits at optional cost.

#### Broad line!



Size 00



Size 0



Size 1



Size 2



Size 3



Size 4



*A new addition to the famous three star line*

# New! Save space and money with Cutler-Hammer's Size 00 A-C Magnetic Starter

**Takes up to 20% less space... costs 18% less than Size 0 Starters.** Now you get two big new bonuses in control selection... less space and less money Both with the all new Size 00 Starter.

Before, you had to use a larger starter in applications where it really wasn't needed. But, now you can use the Size 00 in about 40% of the applications where the Size 0 is usually used.

The new Cutler-Hammer Size 00 Starter performs to the same high standards you get from all Cutler-Hammer Starters. And, you still get vertical, dust-free contacts which add so much to more reliable starter performance. Your choice too, of 2-coil or 3-coil overload

protection in the same small enclosure.

The Bulletin 9586 Size 00 Starter can be used on any general application. Its maximum horsepower ratings: Three phase: 208/220 volts, 1½ hp. 440/550 volts, 2 hp. Single phase: 115 volts, ½ hp. 230 volts, 1 hp. It's available open or in NEMA 1 enclosure. Send for Pub. LO-40-A241.

**Why you get more from Cutler-Hammer.** New things are happening at Cutler-Hammer—new, better products, new engineering ideas and talent, new plant capacity. We're on the move. And, we'd like to show you how we could help you in any electrical control problem. Contact the nearest Cutler-Hammer distributor.

**WHAT'S NEW? ASK...**

## CUTLER-HAMMER

Cutler-Hammer Inc., Milwaukee, Wisconsin • Division: Airborne Instruments Laboratory • Subsidiary: Cutler Hammer International, C. A. Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S. A



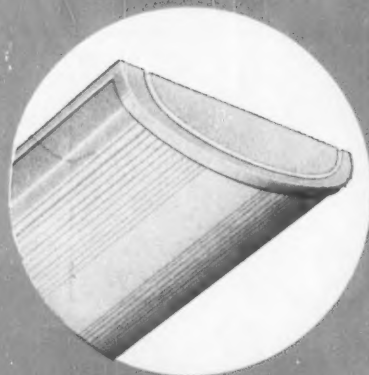
Four-lamp unit  
No. 5024 illustrated



## Newly Improved in Three Ways THE GARCY ULTRA-LUX



Owens-Corning Fiberglas . . .  
exclusively available in  
curved panel for Ultra-Lux



Soft white diffusers in  
choice of polystyrene or acrylic

- New Fiberglas diffuser
- New uniformity of brightness
- New and distinctive styling

**NEW CHOICE OF DIFFUSERS.** A Garcy first . . . Owens-Corning's polarizing Fiberglas in a curved panel. In milk-white diffusers, our Koppers Even-Glo polystyrene and Plexiglas acrylic are the finest available.

**NEW SURFACE BRIGHTNESS CONTROL.** A slight alteration in the relationship of the diffuser to the lamps has completely eliminated shadows and lamp images, resulting in uniformly soft surface brightness across the entire panel.

**NEW STYLING.** The shallow, ceiling-hugging design that gives Ultra-Lux its "built-in look" is unchanged but the end has been re-styled for a cleaner, trimmer appearance.

The Ultra-Lux is available 12" wide (two-lamp 4 ft. or 8 ft.) and 24" wide (four-lamp 4 ft.) as shown above.

Send for newly published Bulletin 60-C

### GARCY LIGHTING

Div. of Garden City Plating & Mfg. Co.  
2475 Elston Avenue • Chicago 47, Ill.



## *Beyond One Trillion Kilowatt-hours*

The almost incredible total of one trillion, or 1,000 billion, kilowatt-hours annual production of electricity in the U. S. will be reached in the early 1960's. Last year production reached a record total of 845 billion kwh, excluding imports. There is a reasonable probability that, with normal economic growth, the trillion mark may be topped in 1962.

Growing electrical production requires a concurrent growth in application and use. Fortunately, the prospects for continued increases in electrical utilization are highly favorable. The devices and equipment that can contribute to large increases in the use of electricity for the future are already available or in sight. Areas of under-utilization, by contemporary standards, are widely prevalent, even conspicuous.

Sustained growth, however, won't come naturally. It must be built, step by step, by every segment of the industry, supported by every individual. Kilowatt-hour statistics measure the use of electricity, but even more, they provide an index to the performance of the industry as a whole. Much of the future market must be created by moving the whole level of electrical utilization upward in areas where urgent needs are no longer self-evident to the public.

The challenge of the sixties to electrical men is not going to be easy. Some of our best prospects, like lighting, are in areas now served electrically but at substandard levels. Others, like cooling and heating, are encountering strong resistance and vigorous competition from other services. It is increasingly important that electrical progress has the active support and encouragement of all of our people.

In the field of lighting, the highly significant illumination level recommendations resulting from the Blackwell research have had considerably less than full industry support. The active endorsement of all of these technically qualified to advise the public is needed to build this vital part of our growth potential. In the field of electric heat there are still large areas of industry indifference which can seriously retard the growing public interest and demand. Such feet-dragging we can ill afford in these crucial times.

Pushing for the trillion kwhr bench mark and beyond is going to take a lot more dedicated initiative and sales effort on the part of the whole industry than we have seen before. It will involve new generations of apparatus, appliances, equipment, lighting levels and marketing ideas. But the stakes are high and the continued growth of the electrical industry is a vital measure of our total economic progress.

*Wm. T. Stuart*

**KNOW YOUR  
SYMBOLS**



This symbol stands  
for fusible switch



This symbol stands  
for QUALITY

**THE SAFETY SWITCH THAT CHALLENGES COMPARISON . . .**

## Bulldog's general-duty safety switch!

- Minimum arcing—double break switching
- Arc control—Vacu-Break® principle
- Pressure contacts—Clampmatic® spring action
- Positive switching—direct handle operation

**. . . plus, all current-carrying parts are silvered.**

Available in NEMA 1 and NEMA 3R enclosures . . .  
competitively priced. Write for details!



Bulldog Electric Products Division, I-T-E Circuit Breaker Company, Box 177, Detroit 32, Michigan. In Canada: 80 Clayson Rd., Toronto, Ont. Export Division: 13 East 40th St., New York 16, N. Y.



**I-T-E CIRCUIT BREAKER COMPANY**  
BULLDOG ELECTRIC PRODUCTS DIVISION

# Outlook for 1961

Favorable prospects in new construction and modernization for the new year indicate a moderate increase in electrical construction, installation and maintenance activity.

**E**LECTRICAL work in 1961 should show a gain of about 8% in dollar volume over 1960 consisting of about 4% increase in costs and about a 4% gain in physical volume. This appraisal is indicated by current trends and future prospects and assumes a relatively stable or sideways movement in the total economy for the months ahead.

If public works programs now under discussion are accelerated to offset declining employment in other industries the gain could be greater, particularly after the second quarter. Most observers believe that public works outlays by the new administration will be at a significantly higher level than in the recent past.

Labor costs, both wages and

benefits, are expected to increase at about the same rate as previous years. Material prices can go nowhere but up from chaotic 1960 levels when extra discounts from published prices were more the rule than the exception for many products on any sizable order.

## Construction

The Department of Commerce reports that outlays for new construction are expected to rise 4% to a record \$57.3 billion in 1961, surpassing the 1959 peak of \$56.2 billion. The 1960 figure may reach \$55.1 billion. If anticipated outlays eventuate, 1961 will be the second highest year in the physical volume of work put in place (expenditures adjusted for price changes) 2% below 1959, a year marked by strong influences carried over from anti-recession measures of 1958.

Although public construction is expected to increase greater relatively (5%) than private construction (3%) in 1961, almost two-thirds of the \$2.2 billion rise in total outlays are expected to be accounted for by the private sector. With a few exceptions, in the commercial and public utility and sewer categories, almost every type of public and private type of construction is expected to either equal or exceed 1960 levels. Outlays in 1960 are generally very close to the 1959 record levels for public and private categories.

Private construction in 1961 should pass the \$40-billion mark for the first time despite the fact that its most important sector—

## Electrical Work

(Millions of Dollars)

	1959	1960 <sup>1</sup>	1961 <sup>2</sup>
<b>Private Funds</b>			
Residential.....	980	880	905
Industrial <sup>3</sup> .....	356	480	527
Commercial & Institutional.....	842	920	950
Utilities <sup>4</sup> .....	370	390	407
Farms.....	96	91	91
Other.....	8	10	10
<b>Total Private.....</b>	<b>2652</b>	<b>2771</b>	<b>2890</b>
<b>Public Funds</b>			
Residential.....	34	25	27
Industrial.....	62	67	68
Educational.....	337	364	392
Institutional.....	189	193	213
Military.....	40	41	43
Highway and Conservation.....	282	300	290
Other.....	17	18	20
<b>Total Public.....</b>	<b>961</b>	<b>1008</b>	<b>1053</b>
<b>Total New Work.....</b>	<b>3613</b>	<b>3779</b>	<b>3943</b>
<b>Modernization and Repair<sup>5</sup>.....</b>	<b>1050</b>	<b>1200</b>	<b>1400</b>
<b>Total.....</b>	<b>4663</b>	<b>4979</b>	<b>5343</b>

### Notes:

1. 3rd quarter estimated.
2. Estimated.
3. Does not include motors, controls or electrical equipment which are part of machines or manufacturing processes.
4. Does not include electrical apparatus used in generation and distribution, nor communication equipment.
5. Does not include replacement lamps.

new dwelling units, where 1.3 million starts are expected—will account for 8% lower expenditures than the almost \$25-billion peak of 1959. Public outlays, exceeding the \$17 billion mark for the first time, will reflect a sustained upward movement of educational construction reaching the \$3-billion level, a volume exceeding expectations despite the growing shortages of classrooms.

The outlook for new construction in 1961 is based on the assumption that the Nation's total output of goods and services will remain at about 1960 levels. It is further assumed that, while the nation's economic pace in 1961 will not push most construction categories significantly, the public area will benefit from higher spending by State and local governments, as well as by the Federal Government. Construction costs may rise somewhat less than in 1960.

### **Housing Starts**

Approximately 1,350,000 private (farm and nonfarm) and public new housing units will be started in 1961, compared to about 1,300,000 in 1960. Included in the 1961 figure are about 50,000 publicly-owned units, 10% more than in 1960. It is assumed that new farm housing construction will remain stable. The outlook for privately-owned housing starts in 1961 of 1,300,000 assumes a strong recovery in the second half of 1961 which will bring seasonally adjusted rates beyond those suggested by the approximate total 50,000-unit increase in 1961.

Rising vacancy rates, relatively high interest rates, and rising construction costs are among the key factors adversely affecting the housing supply-demand situation. On the other hand, the low down-payment requirements and the trend towards a lengthened period for mortgage amortization continue to be favorable influence.

### **Private Construction Expenditures**

Expenditures for private residential buildings (nonfarm) in 1961 are expected to amount to \$22.6 billion of the \$40 billion foreseen for all private construction. The 3% advance, although small, represents the continuation of a

substantial upward trend for non-housekeeping construction and a smaller rise for additions and alterations, and marks a partial recovery from the \$3-billion drop from \$19.2 to \$16.3 billion in new dwelling units expenditures between 1959 and 1960. The sustained trend of apartment house construction, although helping to maintain the over-all level of housing starts, results in a less than proportionate increase in total expenditures because of the lower unit costs involved. In nonhousekeeping outlays, the anticipated attainment of a \$1-billion level, the ninth year of steady gain, represents a doubling of the 1957 volume of \$500 million. The expected 11% gain between 1960 and 1961 follows a 17% rise in 1960. New motel construction continues to be the force in this category.

While residential construction sagged in 1960, the nonresidential building category soared by \$1.2 billion to record levels, exceeding \$10 billion. The 14% gain was mainly accounted for by a spectacular rise in industrial construction, for which an \$800-million advance (38%) is indicated. The prospect for total nonresidential building construction outlays in 1961 is that of a 5% increase.

### **Industrial**

Somewhat uneven movements among the components of the gross national product, indications of a reduction in business profits, and continued emphasis on modernization rather than increase of capacity will probably slow down the sharp upswing of recent years in new industrial building. Although research, and development still provides a strong source of demand for new structures, industrial construction appears to be in line for only a 7% gain in 1961. Much of this rise is a carryover of activity from incomplete projects begun in 1960. The anticipated \$3.1 billion level for 1961 equals the outlays in 1956, which were surpassed only by the 1957 high of \$3.6 billion.

### **Commercial**

Commercial construction in 1960, while falling somewhat short of previous expectations, rose 3% and is expected to rise another 2% in 1961. In both 1959 and 1960, the

two components of this category—office buildings and warehouses, and stores, restaurants, garages—have accounted for almost equal volumes of spending. In 1961, construction of office buildings and warehouses is expected to increase 10% as the office building boom makes itself strongly felt. The stores, restaurants, and garages group, which barely exceeded its 1959 level in 1960, is expected to decline by about 5%. In office buildings, the drive for modern conveniences and for prestige associated with new ultramodern office buildings (centered mainly in New York City, but spreading throughout the country) is resulting in some building ventures that appear to be somewhat speculative in nature. In the stores category, the shopping center building program appears to be more conservatively inspired, the large retail chains increasingly providing the leadership in this field.

### **Institutional**

The construction of other buildings in the private sector has contributed strongly to keeping 1960 expenditures close to 1959 peak levels. The net 11% gain in 1960 for the five categories involved reflects only a minor gain for hospital outlays (barely 1%) but involves substantial 10, 12 and 23% upward movements over 1959 in the religious, educational, as well as the social and recreational categories, respectively.

Outlays in the religious category, reaching the \$1-billion level for the first time in 1960 will likely taper off the rate of gain in this category, which will increase in 1961 only 3%. Similarly, in the social and recreational category, the 4% rise foreseen reflects a strong carryover of work from projects already underway at the beginning of 1961 but implies probable declines in new starts due to the present lower levels of homebuilding.

Private educational construction has recovered from its 1959 drop and in 1961 will undoubtedly continue the 1960 gain.

In the hospital category, the somewhat delayed effect of increased levels of Hill-Burton Federal aid funds now promises a sizable spurt in 1961 spending as a forerunner of further gains in succeeding years.



# New Construction Put in Place in the United States 1959, 1960 and Outlook for 1961

Type of construction	Value (in millions)			Percent change
	1959 <sup>1</sup>	1960 <sup>2</sup>	1961 <sup>3</sup>	
<b>TOTAL NEW CONSTRUCTION</b>	<b>\$56,233</b>	<b>\$55,100</b>	<b>\$57,300</b>	<b>+ 4</b>
<b>PRIVATE CONSTRUCTION</b>	<b>39,892</b>	<b>38,900</b>	<b>40,250</b>	<b>+ 3</b>
Residential buildings (nonfarm)	24,469	21,950	22,600	+ 3
New dwelling units	19,233	16,300	16,750	+ 3
Additions and alterations	4,468	4,750	4,850	+ 2
Nonhousekeeping	768	900	1,000	+11
Nonresidential buildings (nonfarm)	8,859	10,075	10,550	+ 5
Industrial	2,106	2,900	3,100	+ 7
Commercial	3,930	4,050	4,150	+ 2
Office buildings and warehouses	1,954	2,050	2,250	+10
Stores, restaurants and garages	1,976	2,000	1,900	- 5
Other nonresidential buildings	2,823	3,125	3,300	+ 6
Religious	947	1,045	1,075	+ 3
Educational	525	590	650	+10
Hospital and institutional	570	575	625	+ 9
Social and recreational	550	675	700	+ 4
Miscellaneous	231	240	250	+ 4
Farm construction	<sup>4</sup> 1,362	<sup>4</sup> 1,300	1,300	0
Public utilities	4,995	5,275	5,500	+ 4
Railroad	251	300	275	- 8
Telephone and telegraph	952	1,100	1,050	- 5
Electric light and power	2,072	2,050	2,050	0
Gas	<sup>5</sup> 1,600	<sup>5</sup> 1,700	2,000	+18
Other public utilities	120	125	125	0
All other private	207	300	300	0
<b>PUBLIC CONSTRUCTION</b>	<b>16,341</b>	<b>16,200</b>	<b>17,050</b>	<b>+ 5</b>
Residential buildings	962	725	775	+ 7
Nonresidential buildings	4,514	4,800	5,175	+ 8
Industrial	368	400	400	0
Educational	2,656	2,875	3,100	+ 8
Hospital and institutional	428	400	425	+ 6
Administrative and service	568	615	700	+14
Other nonresidential buildings	494	510	550	+ 8
Military facilities	1,488	1,325	1,325	0
Highways	6,000	<sup>5</sup> 5,700	<sup>5</sup> 6,000	+ 5
Sewer and water systems	1,467	1,500	1,525	+ 2
Sewer	906	890	835	- 6
Water	561	610	690	+13
Public service enterprises	551	650	650	0
Conservation and development	1,130	1,275	1,350	+ 6
All other public	229	225	250	+11

<sup>1</sup> Bureau of the Census Statistics except where otherwise indicated.

<sup>2</sup> Bureau of the Census Statistics, Jan.-Oct.; BDSA estimates, Nov.-Dec.

<sup>3</sup> BDSA estimates.

<sup>4</sup> Based on data to be shown in a forthcoming Bureau of the Census release.

<sup>5</sup> BDSA estimates, based on the most recent available preliminary information.

## Utility

Public utility construction outlays, strongly related to the long-term demands of the economy, seem destined to pass the \$5-billion mark in 1960 and promise to gain even further in 1961. However, the various types of construction involved show mixed patterns. Railroad outlays should continue between the \$250 and \$300 million range of the last few years. Telephone and telegraph construction expenditures in 1960 appeared to be approaching a rec-

ord high of \$1.1 billion, barely exceeding the almost identical 1956 and 1957 levels. However, 1961 promises a slight cutback in present programs. Because of the currently adequate power supply, electric light and power construction has stabilized at slightly above \$2 billion.

## Public Construction

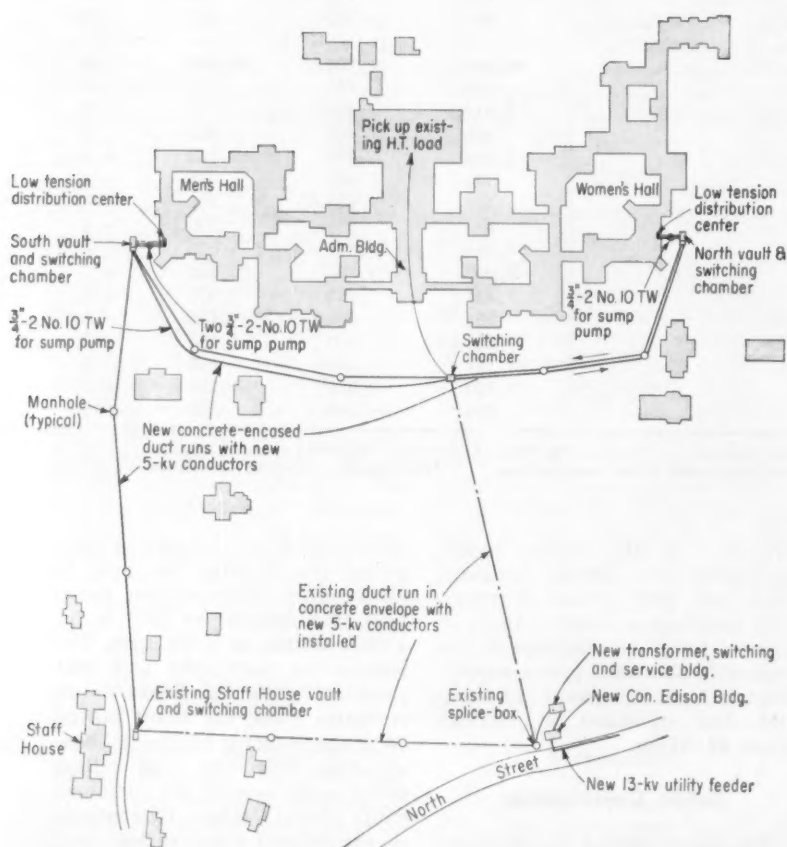
The steady annual rise in recent years in public construction expenditures appears to have been halted in 1960, although a closing

strong finish in a number of categories should bring the total to \$16.2 billion, \$150 million below 1959. The outlook for 1961 is for a \$850 million, or a 5% gain. The outlays for both 1960 and 1961 represent some significant developments: First, the sharp falling off of spending for residential construction from the 1959 billion dollar peak; second, the sustained gains almost certain to continue in educational construction; and third, the resumption of gains for highway construction in 1961 which decreased in 1960.

# Revamping Primary Distribution

Design and construction details in the expansion of an outdoor, underground primary distribution system serving a widespread layout of buildings for New York Hospital, White Plains, N. Y. The electrical system was designed by R. C. Kleinberger, consulting engineer, White Plains, N. Y., and installed by Field Electric Co., Port Chester, N. Y.

By J. F. McPartland



**PLOT PLAN** shows revised layout of the underground primary distribution system. In old layout, one feeder went to Staff House vault and second one went to vault in Administration Building.

**M**ODERNIZED outdoor primary distribution is the key to an expanded electrical system for New York Hospital, White Plains, N. Y. Here, an existing radial primary system was converted to a loop system to serve a widely expanded layout of outdoor transformer load centers. The extensive change was dictated by the continually growing load of light and power in new and existing buildings in the hospital group. A close look at this job reveals a wealth of information on equipment application and installation techniques.

Prior to the recent modernization, the entire ac load of the hospital was supplied by two 4160/2400-volt, 3-phase, 4-wire grounded feeders from a single manhole at the edge of the property. Additional load was and still is supplied by dc generated on the premises. The utility brought a single 4160-volt feeder into this manhole and spliced to the two underground radial feeder runs. One feeder ran to an underground transformer vault adjacent to the staff house, with secondary voltage supply into a 120/208-volt switchboard in the house. The second underground primary feeder ran to the basement of the main hospital building where it served two load centers. One was a transformer for X-ray and the second was a power and light trans-

former load center with secondary feed to a distribution switchboard. Design of the revamped primary system was based on utilizing the existing underground ductwork and incorporating existing transformer load centers into the new distribution plan.

The first step in design of the new system involved consideration of increased service capacity from the utility. But here a snag developed. The utility could not supply more capacity at 4160/2400 volts. Instead, the utility would bring in power at 13,200 volts and transform to 120/208 volts. Such an arrangement was standard for the utility and could be readily provided. The possibility of transforming from 13.2 kv down to 4.16 kv offered simple and effective integration of the existing system, the new system and the new service voltage, but it was ruled out because it would have required transformers, network protectors and other equipment which were not standard for the utility.

Based on utility service at 13.2 kv to step-down transformers for 120/208-volt secondary supply, the new design had to accommodate this utility equipment and provide for tie-in of the existing 4160-volt equipment. The most effective and economical way to solve the problem involved stepping the 120/208-volt power up to 4160/2400 volts. The two transformations are made at the edge of the property line, close to the point at which the utility makes its supply. One small concrete-block building was built to house the utility equipment, and another was constructed to house the step-up transformers and 4160-volt distribution switching center.

The main 4160-volt service building feeds a loop primary which operates normally open, with a separate 120/208—4160/2400-volt 500-kva transformer feeding each end of the loop. Flexibility in the loop provides for sectionalizing of various sections of the system. The use of the loop, in conjunction with a main normally-oper. tie cutout, assures very high reliability for the system, with either 4160-volt transformer capable of handling the entire loop load. The net effect is to minimize the chances of power failure to the buildings.

Protection and control of the primary loop conductors and of the load center transformers are provided by oil-filled cutouts as shown

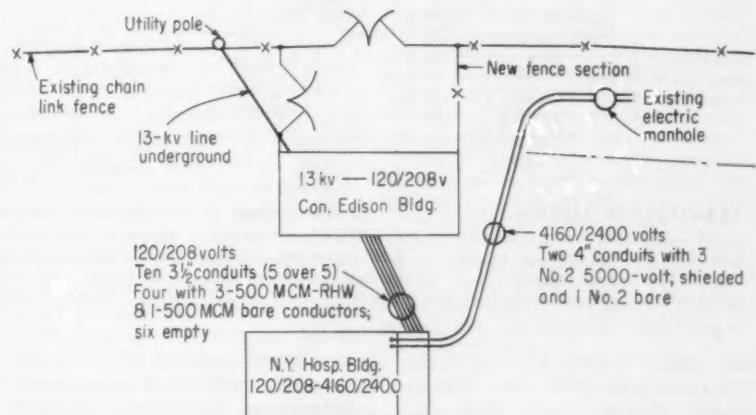


**UTILITY SUPPLY** to the premises is made from an overhead 13-kv pole-line feeder (shown here temporarily supported at top right). Primary conductors will come down pole to conduit (shown plugged) and will enter adjacent utility transformer building underground. This pole line runs along street bounding one side of the hospital property and it carried the previous 4160-volt supply on its top crossarms.

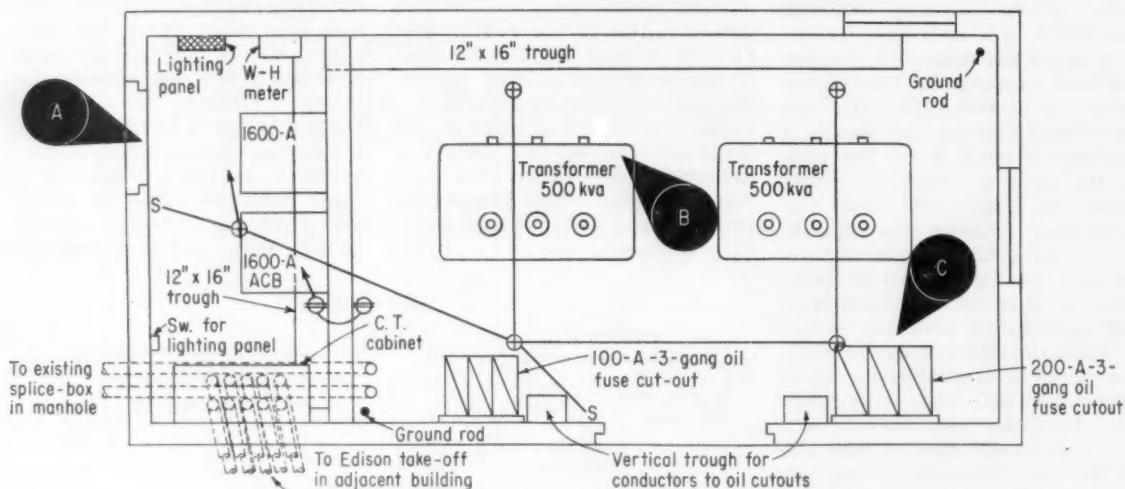
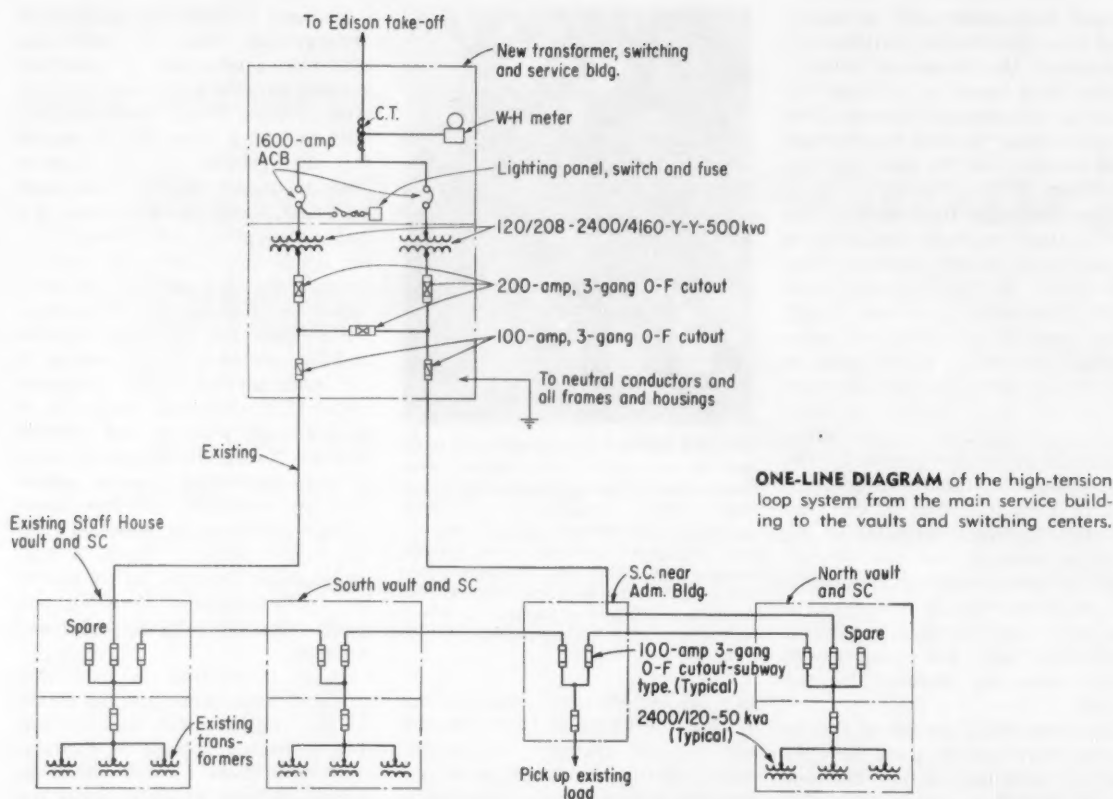
in accompanying illustrations. Within the range of their continuous current ratings (up to 300 amps) oil-filled cutouts provide economical application as compared to load-interrupter switches and high-voltage circuit breakers. All sectionalizing in this system is done with oil-filled cutouts, which offer particular advantage in such application because either terminal on any cutout may be used as a line or load terminal. The internal switching assembly is constructed with a rotating member which bridges the two circuit contacts with no polarity significance.

Primary circuits are made up of underground runs of individual 5000-volt conductors in concrete-encased fibre conduit. Each run consists of three No. 2 insulated conductors and a bare No. 2 neutral for the ground neutral system. Each insulated conductor has heat-resistant, ozone-resistant and low water-absorptive, butyl-based rubber insulation, is internally and externally shielded and has an outer jacketing of neoprene. The conductor strands are specially shielded and this shield is firmly bonded to the inner surface of the insulation material to eliminate ionization of internal air pockets and prevent internal corona discharges. A wrap of semi-conducting film is applied over the insulation and the tinned copper shielding is wrapped over the semi-conducting layer. A neoprene jacket over the entire assembly protects against abrasion, soil acids, alkalies, oils, sunlight and weather.

It is interesting to note that shielded cables were selected by the design engineer for this system. The operating voltage of the system—4160/2400—is well within the maximum limit at which many unshielded cables may be safely and effectively operated. However, there have been cases where unshielded cables used in this voltage range developed trouble due to corona discharge. Further, the National Electrical Code, in Section 710-5, requires that ozone-resistant rubber-insulated conductors, when used as single conductor cables in such a wet location as underground duct, for a grounded neutral system must



**SERVICE LAYOUT** consists of 13-kv utility supply to transformers in their own building, 120/208-volt service conductors to transformers in the hospital's building and the 4160-volt feeders out to the existing manhole at which point the primary loop begins and ends.



**TRANSFORMER BUILDING** (plan view) for the hospital is divided into two rooms for separating the 120/208-volt service CBs from the high-voltage equipment. Each room has its own door to the outside. Separation of high-voltage equipment was provided as a precautionary measure, to provide ready access

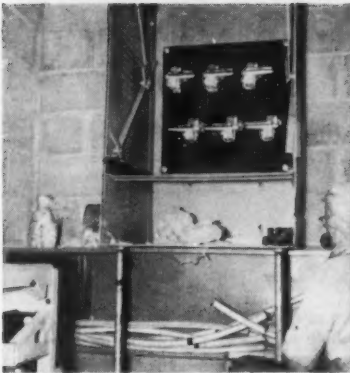
to the meter in the building without exposure to the potential hazard of the high-voltage equipment. Circled letters in this plan correspond to accompanying photos of installation details, with arrowheads indicating angles at which the photos were taken. These photos are at the top of the page at right.

have shielding when the line-to-line voltage exceeds 3000 volts. The Insulated Power Cable Engineers Association sets forth its own recommendations on shielding of rubber insulated cables and recommends that cables with both

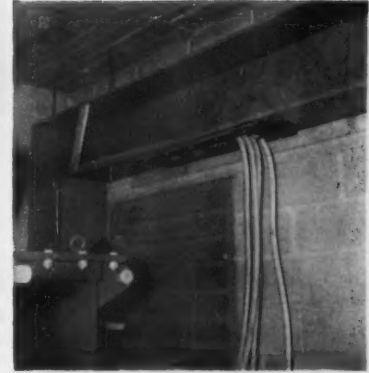
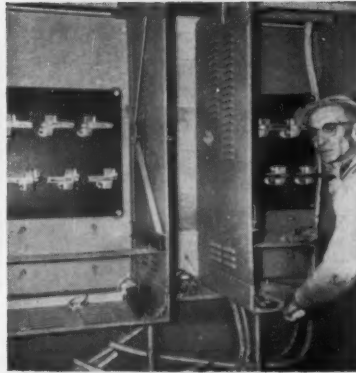
internal and external shielding be used when a grounded neutral system operates with 3001 to 5000 volts between phases. Consistent with the foregoing, shielded cables were used on this job to afford safe application for the underground

circuits of the loop through the underground load centers. Proper shielding prevents destructive attack on cable insulation by corona discharge and makes handling and maintenance safer for personnel. Each of the transformer load





**PHOTO A—TWO ENCLOSURES** for the 1600-amp power circuit breakers providing service disconnect and overcurrent protection are mounted on the cement block wall separating the two rooms in the main service building. CBs are removable type with terminals to engage the line and load terminals shown in the enclosures (left). Line and load conductors are carried in 12 in. by 16 in. trough below enclosure. Trough runs to left, then through wall to high-voltage room, carrying conductors from each CB to its corresponding transformer.



**PHOTO B—METAL TROUGH** for carrying 120/208-volt conductors from service CBs to the 4160/2400-volt step-up transformers is run along back wall of the high-voltage room. Note the use of an ebony plate frame over the opening in the trough through which the conductors drop out to connect to the transformer (in the left foreground).

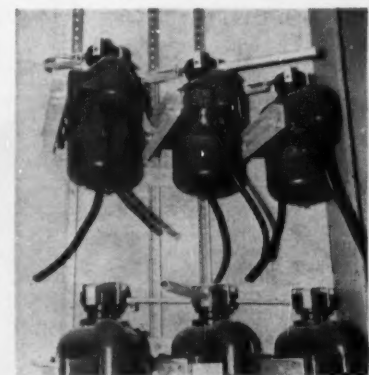
centers includes three single-phase transformers stepping down to 120/208 volts with a wye-wye connection of the units. The main step-up transformers—each a 3-phase unit rated 120/208 volts to 4160/2400 volts—are also connected wye-wye. The wye-wye connection was chosen to provide the desired 4160/2400-volt grounded neutral primary system from the 120/208-volt utility service and the desired utilization level of 120/208 volts from the primary loop. The over-all redesign was greatly influenced by the existing 4160/2400-volt circuits, transformers and other equipment which were to be incorporated in the new layout to minimize costs of the new system.

The use of wye-wye transformer connections is generally discouraged because of a number of objectionable characteristics associated with such connection. First, a connection of this type generally requires that the primary neutral point of the transformer windings be connected to the neutral of the source (which may be the secondary of another transformer or the output of a generator). Without connection of the primary neutral, unbalanced loading from phases to neutral on the secondary side produces a "floating neutral" on the primary side, with a serious unbalancing of secondary wye voltages and reduced power handling capacity. And because the feeder neutral to the transformer primary is absolutely necessary to properly supply

wye-connected loads on the wye secondary, the source from which the primary feeder originates must be provided with a neutral point. Of course, the foregoing objection to a wye-wye connection does not obtain for balanced wye or delta loading on the secondary.

The second, and major, objection to general use of wye-wye connected transformers arises from the character of harmonic currents generated in such a hookup. Under balanced conditions, a 3-phase system operates with a 120-degree phase difference between the phases of the fundamental current frequency and the phases of each harmonic frequency of current, except for the third harmonic and multiples of the third harmonic which are alternating in phase with each other. With sinusoidal applied voltage, magnetizing currents of iron-core transformers contain appreciable third harmonic current. But since the vector sum of currents at the neutral junction in a wye hookup must equal zero, third harmonic currents and multiples of third cannot exist in the primary of a wye-wye connected transformer if the primary neutral point does not have a connection to the neutral of the source supplying the transformer. Without the neutral connection, the third harmonic and multiples of third are eliminated.

When the third harmonic of the primary magnetizing current is eliminated by not connecting the primary neutral, the flux wave is



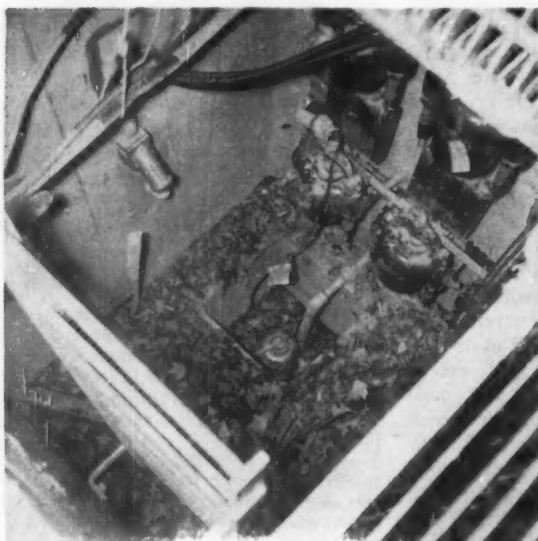
**PHOTO C—OIL-FUSE CUTOUTS** in three banks of three units, with each group of three units gang-operated through a common-handle operating mechanism, provide the functions of switching control, disconnect and short-circuit protection for the origin of the 4160-volt loop system. The 200-amp units shown here serve as primary mains, with the middle bank (at bottom in the photo) as a normally-open tie device for service continuity if one transformer goes out. Pole-type cutouts are used for all of the units in the main service building, with rubber covered leads. The leads will be spliced to the shielded circuit conductors of the underground runs. Cast-type compound connections will be made, with stress cones for the shielded conductors and grounding of the shields to the building ground system. Individual cutouts are mounted on racks which are supported from channel framing bolted to wall.



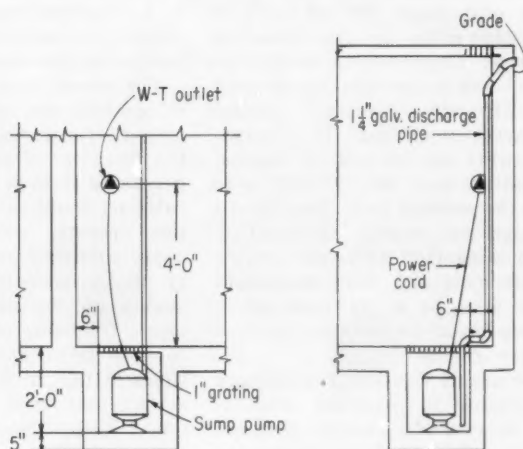
**STAFF HOUSE VAULT** was an existing wye-wye, 4160 / 2400—120 / 208-volt transformer center installed below ground. Here, design engineer R. C. Kleinberger (left) and hospital engineer Robert Hamilton are standing on the grate over the vault. The small building seen through the trees in the left background is the main service and transformer building from which feeder runs to this vault.



**CABLE SPLICES** were made in the manholes which are about 300 ft apart in the long underground runs. Cables were pulled from manhole to manhole between the service building and the vaults. At left, Joe De Markey, general foreman for Field Electric, is making a splice in a 5-kv, shielded conductor. The jig shown here was constructed by De Markey to facilitate the task of making effective splices. The top blocks on the stand hold the two cable ends in a straight-line, concentric butt to assure uniform thickness of the splice insulation placed on the conductors. If the intersection of the two ends made other than a 180° angle, weak spots might be created in the applied insulation. Use of the jig permits speed and ease of splicing, without the need for another man to hold the cables. Cast-type splices, available in complete kits, were used with compound poured into a mold set on the splice. Such a jig is worth making if there are more than three splices to be made. It was used for over 40 splices on this job. A finished splice is shown resting on the base of the stand in the foreground. The three insulated conductors and the bare neutral are seen in the bottom of the manhole at right.



**SWITCHING COMPARTMENT** in center of loop layout contains O-F cutouts for sectionalizing and for feeding to the existing high-tension load in the Administration Building. This underground center, like the transformer vaults, is



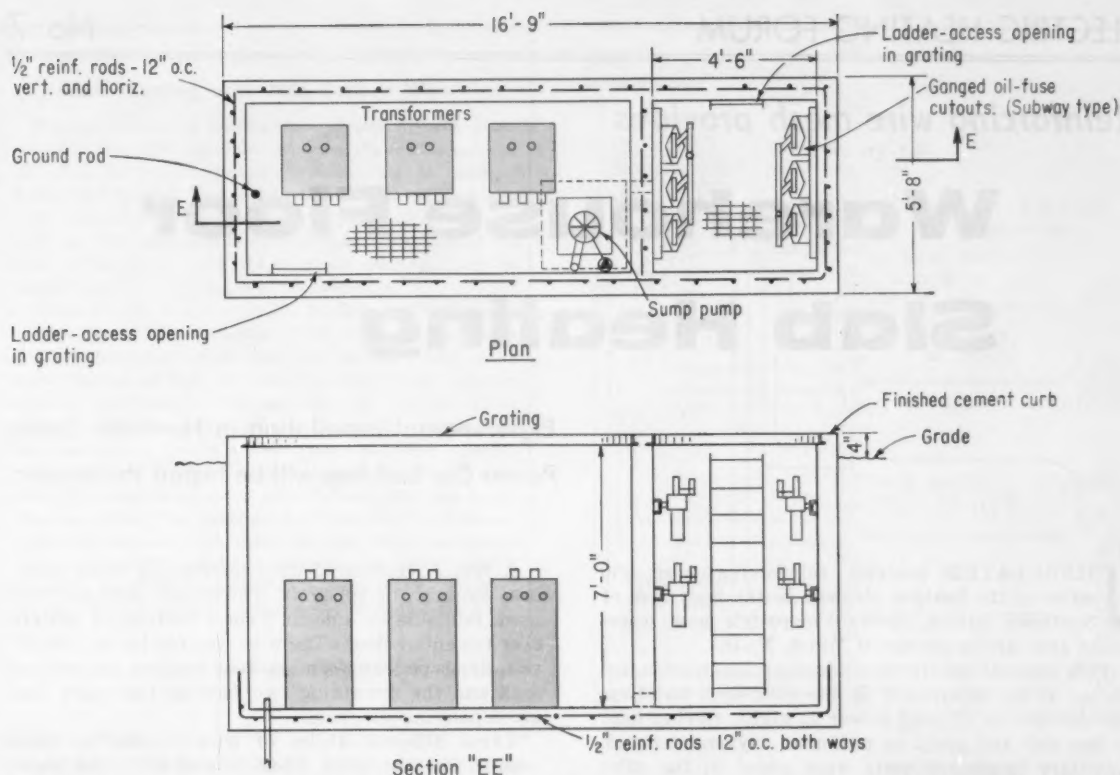
equipped with sump pump for removing water accumulations (in center of photo). The sump pump is supplied from a 120-volt water-tight receptacle outlet. Details of the sump pump installation are shown at right.

distorted so that appreciable third harmonic voltage is induced in the secondary. In a wye-wye connection, these third harmonic voltages cancel each other between line terminals but they show up in voltages between line terminals and neutral. These harmonic voltage waves assume a phase relationship with the fundamental voltage wave such that

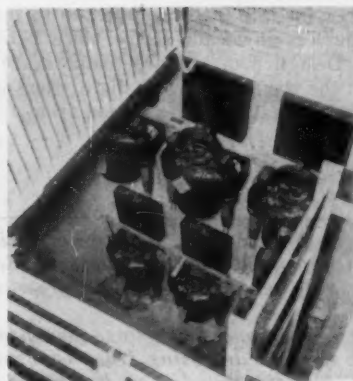
the windings can be subjected to severe overvoltages. Voltage peaks of nearly twice normal amplitude can subject insulation to destructive magnetic stresses, even destroying the transformer.

There are two basic ways to eliminate the aforementioned effects due to wye-wye transformer connections. The simplest way is to

provide a primary neutral to permit third harmonics in the transformer exciting currents, thereby producing sinusoidal flux and sinusoidal secondary voltages. This solution has the objection that the primary harmonic current flow may possibly produce interference on telephone lines. The second method of eliminating unsafe voltage



**TYPICAL VAULT** in the primary loop contains transformers and subway-type cutouts, with separable terminals for rubber-covered conductors and with expansion chambers at their tops to secure full interrupting ability even under conditions of complete submersion. Photo (at right) shows cutouts on one wall of vault, looking down through opening in grating. Cables had not yet been connected here.



**BENDING TOOLS** to make repetitive bending of heavy cables a fast and easy operation were designed and made by Joe De Markey, general foreman for Field Electric. He made the two tools of 1/2-in. sq steel stock and welded a hook and yoke on each tool to grip the cable. Using one tool to hold the cable and the second to bend it, the two tools provide mechanical advantage through the long handles. The tools provide for "tailored" training of large cables in tight quarters in switch cabinets and other enclosures.

stresses due to harmonic voltages is to use a tertiary winding in each transformer in a delta connection. The delta tertiary windings short-circuit the third harmonic voltages, producing the third harmonic of magnetizing current for sinusoidal flux. Thus, voltage spikes due to wave distortion are virtually eliminated.

The problem of third harmonics occurs in 3-phase, wye-wye hookups of single-phase transformers and in 3-phase transformers with shell-type construction of core and windings. However, wye-wye 3-phase transformers with core-type construction almost completely eliminate third harmonic flux and, therefore, do not produce an overvoltage

operating condition and do not have third harmonic current.

For given conditions of application, a transformer manufacturer can provide the proper equipment for wye-wye transformation. However, careful attention to voltage levels and circuit design configuration—whether to use wye or delta connections—can often afford real economies by eliminating need for special provisions, such as tertiary windings, in transformers.

Accompanying diagrams and photos reveal various elements of the over-all electrical design of the revamped primary system and show many phases of construction.



*Reinforcing wire mesh provides*

# Warehouse Floor Slab Heating

Experimental installation in Northern States Power Co. building will be tested this winter.

**U**NINSULATED concrete reinforcing wire will serve as the heating element in the floor slab of Northern States Power Company's new warehouse and service center in Minot, N. D.

This unusual electric space heating application, installed as an experiment in the 6500-sq-ft building, will operate on off-peak power at night, storing heat in the slab and earth to minimize daytime demand. Auxiliary baseboard units were added in the office area for late afternoon pickup to insure comfort for the less-physically-active office personnel.

Design floor surface temperature was 80 degrees in the warehouse area, slightly less in the office area; design heat densities varied from 15 to 20 watts per sq ft.

A typical section of wire reinforcing mesh measures roughly 10 by 40 ft. Thirty-two sections were used, laid side by side to form a continuous pattern over the entire floor. The wire was fed by six 280/20-volt, dry-type transformers, four feeding six sections each and the remaining two feeding four each (see accompanying diagram).

Three different styles of wire reinforcing were used in the job: 66-44, 66-66, and 66-88\*. The heavy-

\*Wire mesh type numbers establish the spacing between adjacent wires (by the first pair of numbers) and the wire gauge (by the second pair). Thus the designation 66-44 means that both longitudinal and transverse wires are 6 in. apart and No. 4 gauge (about 1/4-in. diameter).

*The Electric Heating Forum is designed to provide a means of industry-wide communication on electric heating practices and problems.*

*A unique low-voltage floor heating research project departing from conventional use of electrical conductors is discussed this month. Progress of the installation and resulting operating data will be presented in future issues of EHF.*

*Readers are invited to express their opinions; relate their own experience data to the material presented; or submit new ideas, research data, or case studies on any aspect of electric heating. Please address correspondence to:*

*Electric Heating Forum  
Electrical Construction and Maintenance  
330 W. 42nd Street  
New York 36, N. Y.*

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**SECONDARY FEEDERS**, shown before installation of transformers, energize bus through bolted connectors. The two 2 1/2-in. conduit stubs shown will carry primary feeds to two of the transformers mounted side-by-side on a platform above the floor. Mesh and cables were later covered with the final concrete pour.



### Slab Heating with Non-Copper Wire\*

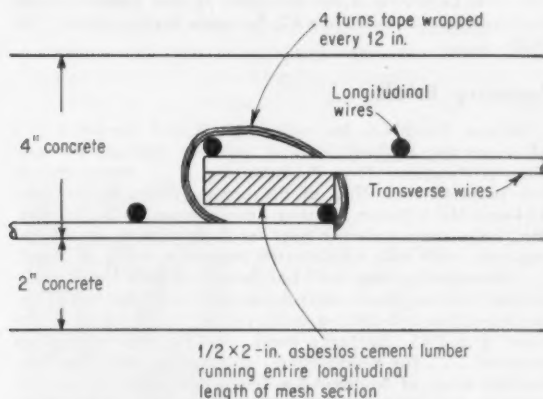
First experiments in heating slabs electrically with material other than wire manufactured especially for the purpose was done by the Commonwealth Edison Co. in Chicago, dating back to 1945. Expanded metal or diamond mesh was used in three installations between 1945 and 1957; wire mesh was first suggested in 1957 to take advantage of the ease of installation and the economy accompanying its double function of heating and reinforcing.

Edison erected a service facility in that year to test such an installation. After favorable results, laboratory tests were made to determine current flow relationships in wire mesh. It was discovered that, as current increases in a magnetic material, resistance of the material due to skin effect decreases, decreasing the effective resistance. Subsequent tests have shown that in a given length of fabric, approximately 95% of the total current follows the shortest path along the longitudinal wires, with relatively little flow in the transverse wires. The combination of skin effect and mutual inductance between wires make straight Ohm's Law application inaccurate. Careful engineering of feeder size is necessary to avoid making the feeders actual "heaters" because of their resistance with respect to that of the mesh.

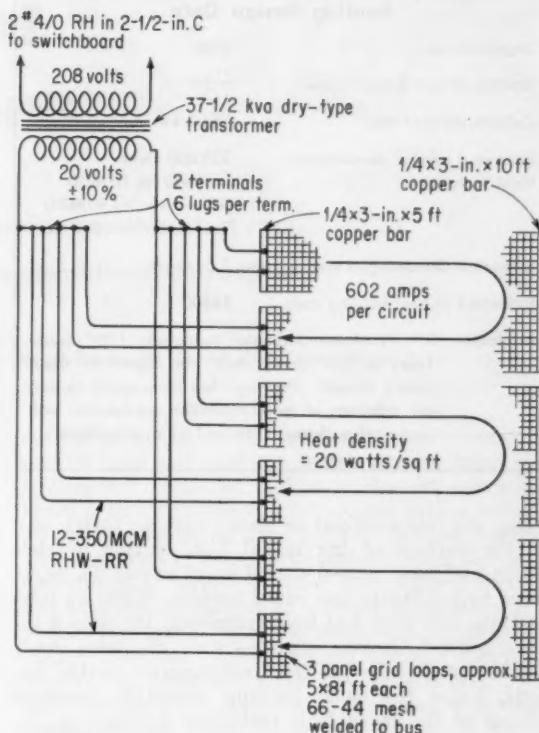
est size (66-44) was chosen for the greatest part of the warehouse area to carry the design current. In the office area, 66-66 was used. The smaller wire (No. 6) produced lower current and thus a lower floor temperature, which was desired. The 66-88 was used in a portion of the warehouse which required less current.

Transformer output was carried by cable to sections of copper bus bar to which the ends of the reinforcing wires were welded (see photo). The current was carried away from the transformers by one section, back by the next. Adjacent mesh sections were overlapped but isolated electrically by long strips of Transite placed between and taped to the sections.

\* See also "Radiant Floor Heating," *Electrical West*, Aug., 1959, and related comments, Oct., 1959.



**ADJACENT WIRE MESH** sections actually overlap to provide continuous reinforcing for concrete. To isolate the sections electrically, asbestos-cement strips were placed between the sections at the edges and taped in place.



**TRANSFORMER SECONDARY** connections illustrate method of feeding wire mesh. Current is carried from one side of transformer along longitudinal wires of one mesh section, through 10-ft copper bar, and back to transformer through adjacent mesh section.

In spite of the inherent safety accompanying the 20-volt potential used, obstructions such as drains, columns, and conduit were isolated from the reinforcing mesh either by insulating, cutting or detouring the wire.

The 6-in. floor slab was laid in two sections. All



**OVERLAPPED EDGES** of grid sections, temporarily blocked up to provide working room, were insulated from each other by asbestos-cement strips and taped in place.

### Heating Design Data

Degree-days:	9100
Outside design temperature:	-30F
Calculated heat loss:	183.2 kw
Estimated annual consumption:	300,000 kwhr
Heat factors:	5.1 kwhr/sq ft/MDD 0.314 kwhr/cu ft/MDD 1.64 kwhr/installed watt
Estimated demand and energy rate:	1.5¢/kwhr
Estimated annual heating cost:	\$4500
Insulation:	2" Styrofoam perimeter insulation; 1½" Styrofoam in wall cavity; two 1-in. layers of fiberboard in roof. (Provision has been made to permit addition of more insulation on interior wall and roof surfaces if desired at a later date.)

wires and bus were put in place (without fastening) on the surface of the initial 2-in. section of slab which had been poured over 6 in. of gravel fill, separated by a polyethylene vapor barrier. When all connections and tests had been completed, the final 4 in. were poured. It was expected that the wire mesh would rise slightly into the fresh concrete during the pour, hence the usual hooking operation (manual lifting of the mesh to a mid-point position in the fresh pour) was not done, to avoid any possible displacement of the Transite insulating strips. After final setting, 1½-in.-deep contraction joints were sawed in the slab, separating it into five sections each approximately 17 by 40 ft in area.



**LONGITUDINAL WIRES** of reinforcing mesh were welded to ¼ by 3-in. copper bar at each end. Clamps keep wire in close contact with bar during welding operation

Temperature control is accomplished by an interconnected system of air, slab, and outside thermostats which alternately energize and deenergize the transformers. By putting the controls in the 208-volt primaries, working with the high secondary currents (500 to 600 amps) was avoided. Time clocks restrict operation to off-peak hours.

The electrical contractor on the job, Holmes Electric Co. of Minot, N. D., did all the fastening, tying, and connecting of the fabric as well as supplying and connecting the transformers. Electrical consulting engineer was Kenneth O. Tompt of Fargo, N. D.; technical adviser in charge of design was Harold Teachout, Northern States Power Co. engineer.

### Literature Available

A new revised edition of REA Bulletin 142-1, **Electric House Heating**, is available at 20 cents per copy from the Rural Electrification Administration, U. S. Dept. of Agriculture, Washington 25, D. C. A brief review of heating principles is followed by descriptions of available heating and control equipment, construction and insulating requirements, methods of computing heating capacity, and cost estimating.

**Automotive bumper stickers** bearing the message "You Can't Beat Electric Heat" in white and red on a black background may be ordered from R. D. Smith, Secretary, Consumer Products Div., NEMA, 155 E. 44th St., New York 17, N. Y., at \$8.00 per 100. The adhesive-backed strips measure 4 by 14½ in.

A comprehensive booklet on electric furnaces for space heating and air distribution is available without charge from Lennox Industries Inc., 200 S. 12th Ave., Marshalltown, Iowa. **Fresh Air Electric Heating** discusses the principles of ducted central systems, humidity and temperature control, and heater location, together with drawings of typical systems.

**Heating Schools Electrically**, a new bulletin available from Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa., pictures typical applications with a representative breakdown of costs for electric and oil heat.

A 22-page booklet, **Function and Performance of Thermal Insulation**, is available from Wood Conversion Co., First National Bank Bldg., St. Paul 1, Minn., describing the functions, requirements, efficiency, and installation of insulation and its application in electrically heated homes.

The Visking Co., 6733 W. 65th St., Chicago 38, Ill., is offering a new 8-page booklet on VISQUEEN polyethylene film used as a **vapor barrier** under slabs, in crawl spaces, and on subflooring; on the warm side of walls and ceilings; or as concealed flashing.

Special heavily asphalted **insulation support boards** designed for installation between joists and studs in crawl spaces, ceilings and knee-wall applications where insulation is to be blown in are described in new bulletin issued by Air-O-Cel Co., P. O. Box 62, Ferndale Station, Detroit 20, Mich.

### Industry Briefs

Bulova Watch Co. Inc. will produce and market a line of automatic radiant heating controls through its subsidiary, American Time Products, Inc. . . . Westinghouse has reported that 97% of the home owners in the new 154-unit Mark Twain housing development in St. Charles, Mo., have chosen electric heat for their homes. An adjoining tract with 650 total-electric homes is being planned. . . . Minneapolis-Honeywell has developed new line-voltage electric heating thermostats designated T-40 (for low-mass, quick-heating-and-cooling units, cycling up to 20 times per hour) and T-41 (for large mass, slow-heating-and-cooling systems). . . . The Refrigeration and Air Conditioning Contractors Assn. of Southern California has adopted rules of practice for contractors installing heating and cooling equipment to facilitate the checking of installation plans required by the city of Los Angeles. . . . Apexro Products Co. has begun work on a second plant in Los Angeles for production of radiant heating products.

# Input Control of Infrared Heaters

reduces operating cost, permits adjustment of radiation intensity to produce conditions of comfort.

By Lowell R. Mast, *Electromode, Div. of Commercial Controls Corp., Rochester, N. Y.*

**T**HE specialized applications for which infrared radiant heating is suitable\* usually make conventional thermostat controls impractical. The heating rate of an individual infrared unit may be varied, however, through use of an input controller, or percentage timer.

Such a device is simply an electric clock mechanism which repeatedly opens and closes a single-pole, single-throw switch at intervals determined by the dial setting, providing efficient stepless control without the need for expensive rheostats. Time cycles generally recommended for infrared heaters are 15, 30, and 60 seconds, the 30-second cycle being the most commonly used.

The controller switches the current on and off in accordance with a pre-set percentage of the total cycle, the setting being accomplished manually by means of a pointer and graduated dial on the unit (see photo). For example, a 30-second controller set at 50% would provide an "ON" period of 15 seconds followed by an "OFF" period of 15 seconds, etc. Thus if this setting were used on a 2-kw heater, the net result would be the same as with a 1-kw heater operating continuously.

Since heaters are normally sized for the coldest ambient conditions expected, such ON-OFF control is desirable to reduce the net heat and provide comfort under less-severe conditions. The controller can be set to give any combination of ON-OFF time between 0 and 100%.

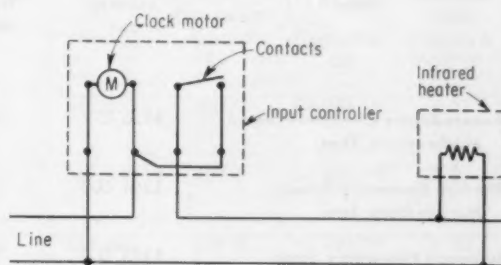
Two general types of controller are available: for carrying full heater current, and for pilot duty. Heater loads not exceeding the controller current rating may be carried directly; for pilot duty, a high-

cycle-duty contactor of sufficient capacity must be used to open and close the heater circuit. Input controllers are rated for 120- and 240-volt operation; hence a 120- or 240-volt pilot circuit with a suitable 440-volt contactor is required for 440-volt heaters. The economics of each particular situation should be considered to arrive at the best control method. For example, in the case of a 12-kw installation, it is usually less expensive to use three load-carrying controllers than one pilot-duty controller and contactor, considering labor and materials. In addition, three opportunities for control within the area are provided instead of one.

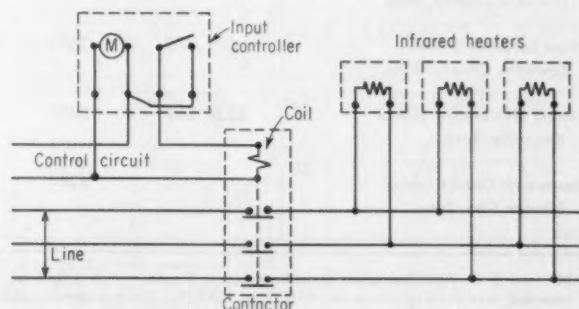
The accompanying diagrams illustrate connections necessary for both direct and pilot control.

\*See "Infrared Spot Heating," EHF No. 5, November, 1960.

## LINE-VOLTAGE CONTROL OF HEATERS



## PILOT CONTROL OF 3-PHASE CIRCUIT



**TYPICAL INPUT CONTROLLER** for direct loading. Model illustrated is rated for a non-inductive load of 25 amps, 120 volts, or 20 amps, 240 volts.

## The Case for the

# All-Electric School

A short summary of advantages the electrically heated school has to offer.

**L**EADING educators, school boards and architects are taking a long, hard look at the growing number of successful all-electric schools in this country. Mounting costs of construction materials, labor, and combustible fuels coupled with the relatively constant cost of electrical energy are producing an increasingly favorable balance in the electric heat column.

Last year the Edison Electric Institute listed 208 electrically heated schools in this country.<sup>1</sup> Construction during the past year has certainly increased this total considerably.

The narrowing margin between fuel and electricity rates is only one aspect of the bright picture. Electric heat reduces installation costs, interest on the initial investment, maintenance, and depreciation. Elimination of the boiler or furnace room, piping or

stack, and fuel storage space permits additional much-needed classroom area for the same construction dollar.

Other less-obvious advantages exist. Control of electric heat is simpler and more efficient. It is a known fact that, because of the number of occupants per classroom, the lighting load, and the significant solar contribution, classrooms frequently need cooling instead of heating during winter school hours.<sup>2</sup> With conventional fuels, existing steam lines or ducts (unless they are well insulated) give off heat on the way to the radiators or registers, making accurate control of the temperatures in the intervening areas difficult. When cooling is needed in such areas, this is wasted heat. Individual thermostat control of each room can cut off heat entirely and introduce outside air to rooms requiring cooling without affecting other

### TENNESSEE VALLEY SCHOOLS<sup>4</sup>

School*	Total building cost	Degree-days**	Design temp Outdoor/Indoor (°F)	Total floor area (sq ft)	Installed cost of electric heat	
					Total	Per sq ft of floor area
Reeves-Rogers Elementary School Murfreesboro, Tenn.	\$256,072	3629	0/70	20,103	\$17,000	\$0.85
Bradley Elementary School Murfreesboro, Tenn.	\$264,000	3757	0/70	30,000	\$13,200	\$0.44
Hobgood Elementary School Murfreesboro, Tenn.	\$313,000	3757	0/70	30,000	\$14,000	\$0.47
Motley Elementary School Lowndes County, Miss.	\$94,352	2695	10/70	13,300	.....	.....
West Lowndes School Lowndes County, Miss.	\$99,775	2695	10/70	13,500	\$9,000	\$0.67
Sterchi Elementary School Knoxville, Tenn.	\$337,232	3437	0/70	46,042	.....	.....
Fourteenth District School Johnson City, Tenn.	.....	4264	0/70	7,100	.....	.....

\* All have 2 in. rigid insulation in ceiling except Sterchi, which has 3 in. vermiculite.

\*\* Recorded over heating season in 1958-59 or 1959-60. Heating density and utilization factor calculations in table are based on the normal average degree-days for each area.



areas. Where only portions of a school may be used (evenings, weekends, etc.), local heat can be furnished without the usual inefficiency resulting from central system operation at reduced capacity.

Where future expansion is anticipated, additional electric heating equipment may be added as needed. With fuel heat, an oversized boiler or furnace must be installed initially, with a reduction in operating efficiency until full capacity is utilized; or a new duplicate system must be installed for the addition, at greater expense than would be encountered with electrical equipment.

Further advantages accrue to architect, general contractor, and school through the use of a single electrical subcontractor.

Current serious discussions considering keeping schools open throughout the year introduce the problem of air conditioning—another plus factor for electric heat. Estimates made by responsible people indicate that schools can be built with air conditioning at little or no extra cost than without this facility.<sup>5</sup> If this is true of fuel-heated schools, all-electric schools with air conditioning stand to save the taxpayers' money, since no extra electric capacity is required, and the higher degree of insulation reduces necessary cooling capacity.

With these advantages comes the responsibility of careful planning. Because of the expected large heat gains, required ventilation, desirability of off-hour thermostat set-back, and other irregularities of operation affecting heating requirements, accurate engineering must replace any rule-of-thumb estimating.

The accompanying compilation of construction and operating data of a representative number of all-electric schools in the Tennessee Valley<sup>6</sup> illustrates this point. They are all similarly constructed (brick and concrete or slab block plus concrete slab floor) with similar insulation, yet there is a divergence in the installed heating capacity per sq ft per 1000 degree-days (ranging from 2.67 to 4.22 watts). Assuming that these figures were reported accurately, the difference may be explained by variations in heat gains or expected hours of operation, or by inconsistent engineering standards. Either case is an argument for accurate professional planning.

Unfortunately, submetered heating energy data is not available for these schools. However, the "total energy utilization factor" given in the table may be used effectively in comparing energy costs between schools, heated by either fuels or electricity. Since this factor includes all energy used within the school, it may be multiplied by the cost per kwhr and compared with similar cost factors for fuel-heated schools computed to include the cost of all oil, gas, coal and electricity consumed.

<sup>5</sup>See "Modern Schools are Heated Electrically," published by Edison Electric Institute, 750 Third Ave., N. Y. 17, N. Y. Price \$1.50.

<sup>6</sup>See "Why Are Many Classrooms Overheated?" Heating, Piping & Air Conditioning, January, 1956.

<sup>7</sup>See "Air Conditioned Schools Won't Up Cost Much," Electrical World, Nov. 28, 1960.

<sup>8</sup>From "All-Electric Schools in the Tennessee Valley," prepared by the Tennessee Valley Power Assn. in conjunction with TVA's Electrical Demonstration Branch, Chattanooga, Tenn. Price \$1.00

Connected load (kw)			Heating density installed		Annual load factor (%)	Annual consumption** (total load)			Total energy utilization factor Kwhr/sq ft /MDD***
Heating	Other	Total	Watts/ sq ft	Watts/ sq ft/ MDD		Kwhr	Max increm demand Kw	Operating cost	
306.9	191.0	497.9	15.3	4.22	.....	387,680	280.0	\$2,954.00	5.31
317.5	220.0	537.5	10.6	3.02	24.19	549,440	259.2	\$4,666.72	5.21
356.4	245.0	601.4	11.9	3.39	21.55	688,800	364.8	\$6,063.24	6.55
96.0	104.5	200.5	7.2	2.90	9.86	112,050	129.6	\$1,677.31	3.35
134.5	99.5	234.0	10.0	4.01	8.93	112,682	144.0	\$1,778.93	3.35
537.4	261.4	798.8	11.7	3.41	...	778,100	417.6	\$5,646.30	4.92
96.0	61.9	157.9	13.5	3.27	13.17	95,280	82.8	\$1,094.86	3.24

\*\*\* This is not a true "heat factor," since the energy involved is that used by the total connected load. However, since a major proportion of this energy contributes to heat gains which reduce the net heating requirement, the factor provides an effective means of comparing operation from one school to another.

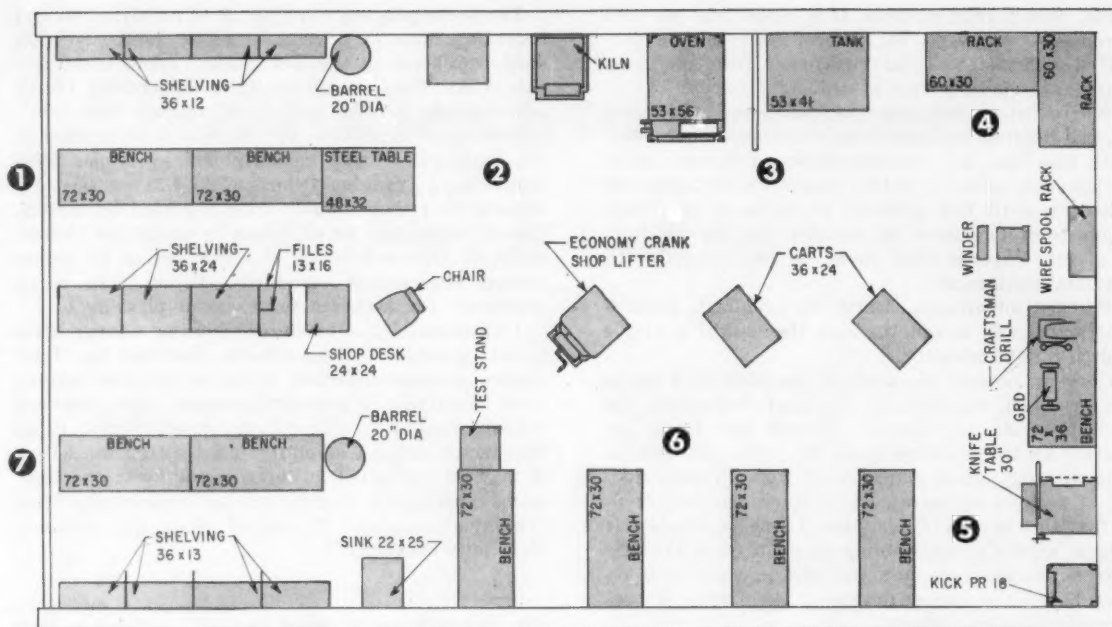


FIG. 1—Layout of a shop capable of 500 motor rewinds a year.

# Setting Up A Rewind Shop

Here are the "WHYs" and "HOWs" of establishing and operating a rewind shop for wide-range service and repair of motors and other electrical equipment in industrial plants.

By John Molnar, P. E., Consulting Engineer, Moorestown, N. J.

**E**CONOMIC justification is always a primary consideration behind any business venture, even though at times the need for such justification may be obscured by false reasoning. This could occur when expediency is the motivating factor, but the final action is determined by economics. The case of establishing a rewind shop is no different.

First of all, what are the major considerations in this area? There are two:

1. WHY establish a rewind shop (this deals with the justification).

2. HOW to establish a rewind shop (this covers the mechanics involved).

To go one step further, the WHY can be subdivided into two groups:

1. NEED

2. WANT

There is a very real difference between the two groups but the end result is the same—a rewind shop will be established.

## The Rewind Shop

At this point a short discourse on the function of the rewind shop is

in order. The omission of the adjective "motor" from the phrase "motor rewind shop" has been intentional for a well-planned and adequately equipped rewind shop will permit the performance of many diverse tasks. These are outlined below, not necessarily in the order of importance:

1. Routine motor overhaul can and should be done in this shop. The electricians, being specialists in motor work, are best qualified to dismantle, clean, replace bearings, inspect windings, reassemble and test motors. Further, all necessary

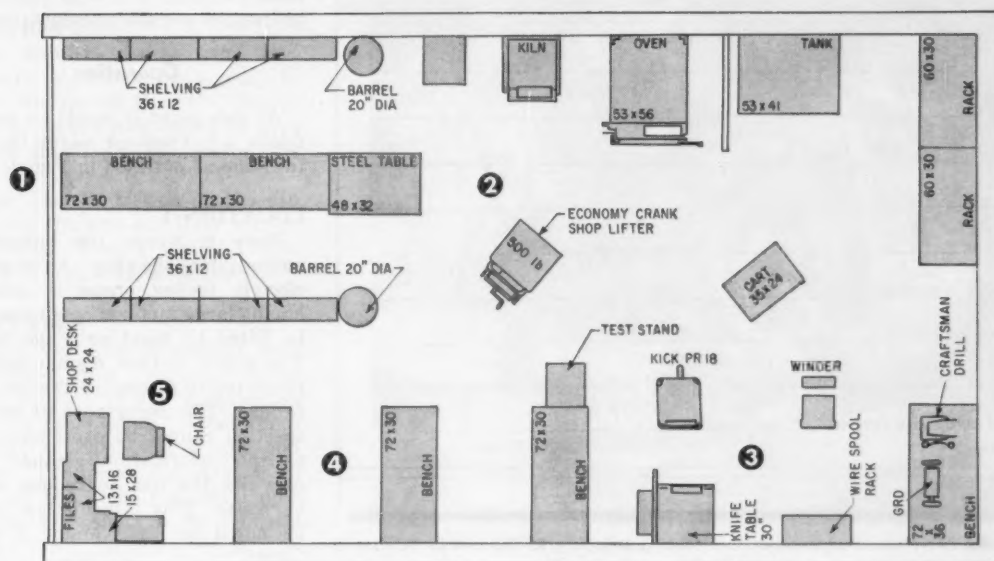


FIG. 2—Layout of a shop capable of 250 motor rewinds a year.

replacement parts are usually stored in this area. Also, as all motor records are kept in this shop, it becomes a simple matter to note overhaul date, extent of servicing, etc., on these cards for future reference. The degreaser can be utilized to clean the motor; and, if necessary, the motor can also be dipped in varnish and baked for added protection. Facilities are available for final painting.

2. Rehabilitation—This is necessary whenever motors, transformers, electrical coils become saturated with moisture due to flood or storm. These devices can be dismantled or stripped down and thoroughly dried in the baking oven. And again, if necessary, they can be dipped in varnish, baked and painted.

3. Reconnecting—Motors can be reconnected for operation on different voltages. The oven is used to soften the varnish to permit lead lifting without damage to the insulation. The motor winders are usually best qualified to handle this rather complex work. Finally, a dip of varnish, bake and a coat of paint completes the job.

4. All motor test work is best accomplished here in the shop. But should field testing be required, the coil winders should be called upon to perform such tests.

5. Winding and Rewinding—

This includes motors, transformers, brake coils, solenoid coils.

From this it is readily apparent that a well-planned and adequately equipped rewind shop becomes a multi-purpose facility. The success or failure of this operation is contingent upon the competence of the personnel.

### Why

As mentioned earlier, there are two reasons why rewind shops are established. One is a need, the other is a want.

1. Need—Need arises when the plant is so isolated that adequate rewind services are not available locally. Economic justification must still be the primary consideration for when it becomes more expensive to rewind a motor than to buy a new one, the purchase of a new one is the answer. Keep in mind that the cost of an adequate supply of spare motors may greatly exceed the cost of a rewind shop where a few different sizes of wire may satisfy the needs of many different motors.

2. Want—It is nice to want a shop but this may be difficult to justify. Quite frequently company owners are lulled into a false sense of competition by considering only the actual cost of the rewind and ignoring overhead which includes

space cost, equipment depreciation, fringe benefits, etc. Unless there is an adequate volume of rewind and overhaul work it is wise to utilize the services of local shops. These shops, where available, can and do offer excellent service at a competitive cost. Many are geared to large volume and offer pick-up and delivery service around the clock.

### How

This deals with the mechanics of establishing a rewind shop. A properly planned shop is one that is designed for maximum efficiency, high equipment utilization and reduced operational cost. Fig. 1 is a typical layout of a shop capable of 500 motor rewinds a year plus an equal amount of overhaul work. The circled numbers indicate the areas where separate operations are performed and are listed in the order in which the work is accomplished. All rewinds enter the shop at 1 and leave at 7, and overhauls enter and leave at 7.

Fig. 2 shows a much smaller layout. This shop can easily handle about one-half the amount of the larger shop. It is readily apparent that the capital investment is also quite a bit less for the smaller layout. Both of these show a practical and functional layout, but of course, personal preference may dictate

REWIND DATA CARD			
Make _____			
Serial # _____		Frame _____	
Hp _____		Volts _____ Amps _____	
Rpm _____		No. of slots _____	
Coil span _____		Turns per coil _____	
No. wires in parallel _____			
Winding connection _____			
Wire size _____		Kind of wire _____	
Lbs. of scrap wire removed _____			

**REWIND DATA** is noted on another form during stripping of the motor, to keep a record of the previous winding characteristics.

MOTOR HISTORY CARD				
Mfg.	Volts	HP	Tag No.	
Serial No.	Amps	Frame	Cycles	
Model	Phase	RPM	Gear RPM	
Type	Date	Service	Bldg.	Floor
Style				
Code				
Design				
Temp. °R.				
Enclosure				
Bearing F No.				
Bearing R No.				
Gear Model No.				
Gear Frame No.				
Gear Ratio				
Agitator No.				
Motopump No.				
Varidrive No.				
Front Side				
Date	Service	Bldg.	Floor	
Rear Side				

**SAMPLE FORM** on which the performance and repair history of each motor is noted during dismantling and inspection of motor, prior to repair.

some modification. In that case, it is well to keep in mind that maximum efficiency and high equipment utilization are the prerequisites.

### Operation

At this point it would be well to follow a burned-out motor through the shop as outlined in Fig. 1.

### LOCATION 1

Here is where the burned-out motor enters the shop. An overhead electric trolley crane is used to handle large motors; small ones can be lifted by hand onto the bench. The motor is then dismantled and inspected to determine the cause of failure. The importance of this inspection cannot be overemphasized as the information gleaned here provides the tool to reduce motor burnouts. This information should be noted on the "Motor History Card."

Every piece should be carefully checked for physical defect for it would be poor practice to rewind the stator of a motor with a faulty rotor and cracked end bell if a new one could be purchased more economically. But if only minor defects are noted, these should be scheduled for repair to coincide with the completion of the rewind. In any case, all parts except the stator should be cleaned and stored in properly identified bins on the large shelves.

### LOCATION 2

On the steel table, cut the winding beyond the stator laminations, at the end opposite the connections, with an air-operated chisel. Then, in the kiln, burn away the insulation and the insulating varnish. This is usually a mass operation and is conveniently done overnight—pure economics. At this point the "Rewind Data Card" is completed, and then the wire is removed from the stator. There is a handy barrel at this location for such scrap as wire, etc.

A degreaser or sand blaster is located in this area for cleaning the stripped stator. The choice is optional; however, the degreaser is more a universal piece of equipment. Cleaning the stator is an important operation. Sufficient care should be exercised to insure thorough cleaning. The stator should be examined for burrs caused by shorts or grounds. These should be removed as they can



puncture the new insulation and cause a repeat failure.

### LOCATION 3

The varnish-dipping tank and oven are separated by a wall to reduce fire hazard. Here the cleaned stator is dipped and baked to provide an insulating surface on the iron.

After the completion of the dip and bake the slot cell liner size is determined. Then a sample coil is wound to establish dimensions.

### LOCATION 4

The correct size of magnet wire is selected from the steel racks where it is stored and mounted on the wire spool racks. From there the wire is fed to the electric coil winder. The usual procedure is to wind all the coils for one motor and then store them on the winder's bench.

### LOCATION 5

Here the slot cell liner is cut on the knife table and formed to fit the contour of the slot on the kick press. Phase separators, slot sticks and end separators are also cut to size here.

### LOCATION 6

At this point the stator, coils, and insulation meet and the motor winder goes to work. The motor leads are connected and coil ends are tied securely in place.

Then back to 3 for dipping and baking as required, after which the excess varnish is scraped from the stator to eliminate interference. Within easy reach is the bin with the matching parts to facilitate assembly. A test should be conducted after the completion of the rewind. Usually a Megger reading to ground, a resistance reading between phases, and a no-load current check is sufficient. But the only true test is conducted at full load, with a speed check and power and power factor readings.

Finally, a coat of paint and another rewind is completed.

### LOCATION 7

Here the motor is loaded onto some vehicle and transported either to the storeroom or installation site.

### Shop Accessories

The economy hand-crank shop lifter was included to be used in

lieu of the overhead electric trolley crane with satisfactory results where economics limit expenditures.

There is sufficient paper work here to justify the inclusion of a shop desk. The card files are located within easy reach of the shop superintendent.

A drill press and electric grinder

are necessary adjuncts to a rewind shop.

The carts have heavy-duty casters to provide mobility for larger stators and expedite handling of groups of smaller parts.

The sink may be considered a luxury but it does greatly reduce time spent traveling to and from washings.



**SLOT CELL LINERS** are formed to fit the contour of the slots and inserted in place.



**MAGNET WIRE** is carefully wound on an electrically operated coil winder. Aluminum guide spools are used to yield properly formed coils. Note the counter in front of the operator, on the machine. This is used to eliminate human error in keeping track of winding turns.

## Plus Values of Good Tool Equipment

By Ray Ashley, Research and Consulting Engineer, Oak Park, Ill.

**QUESTION:** *Aside from immediate man-hour economies, are there other advantages to having a job well equipped with tools?*

**ANSWER:** *Yes. Among them are: 1) reduced hazards; 2) retention of the better mechanics; 3) reduction of fatigue; 4) better workmanship; and 5) favorable impression on the buyer of your services.*



**SIDE-SLUNG** mobile platform provides sure footing for electricians installing busway under crane girder; permits men to direct full attention to job at hand.

### DISCUSSION:

*Reduced Hazards.* Sturdy scaffolding, special safety ladders, hydraulic booms, chain-hoists (for rope block and tackle), and fork lift trucks are just a few of the many "tool" items that minimize hazards to personnel and equipment they are installing. Remove anxiety about a mechanic's footing or method of supporting equipment he is working on and his installation productivity will go up. It is a psychological boost to the normal physical advantages of using good tools.

*Retaining Mechanics.* Good mechanics need, and are becoming accustomed to having, an adequate supply of high grade tools to supplement their natural talents. In fact, adequate job tooling often is an inducement to mechanics and it tends to minimize labor turnover. Unless proper tools are available, mechanics are apt to become discouraged, lose interest in the job, or simply pack up and leave to seek the better equipped projects. Men find work more interesting if they have access to the type of tools that will permit them to boost the quality of their productive efforts.

*Fatigue Problems* are practically nonexistent on jobs equipped with proper power tools. Motor-operated

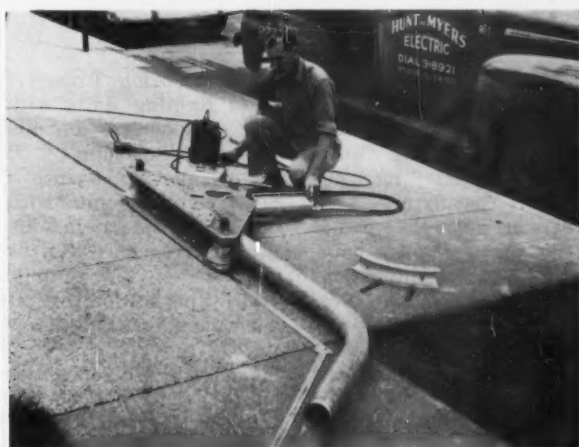
pipe threaders, metal-cutting band saws, power-operated hydraulic conduit benders, cable pullers and winches, lift trucks, etc., substitute horsepower for muscle power and conserve mechanics' strength. Working heavy conduit and handling heavy cables are no longer the back-breaking chore they were years ago.

And the variety of portable dollies, hand trucks and wagon trucks transform material handling into a relatively simple and easy operation. Experience proves mechanics work better when they don't have to wear themselves out on the job.

*Better Workmanship* is a logical advantage of good tool equipment.

Not only do the men work better when less fatigued, but the tools themselves are designed to do a better mechanical job. The motor-operated, one-shot, hydraulic conduit bender is a prime example. With the flip of a lever, a mechanic can make a perfect bend in large conduit. No dents, flat faces or wrinkles in the bend. No waste of damaged conduit sections. The same workmanship holds true of hand benders on smaller conduits.

Metal-cutting band saws, lever-operated shears, electric welders and other shop tools enable mechanics to job fabricate hangers and supports tailored to installation requirements. Cable-pulling power winches, cable rollers, me-



**NO FATIGUE** problem with power-operated hydraulic conduit bending equipment that has finger-tip control. Modern tools increase quality of workmanship.



**PORTABLE BAND SAW** cuts conduit and metal duct in a jiffy. Horsepower replaces musclepower.



**FORK-LIFT** truck is an impressive and versatile piece of job equipment; lifts men and materials quickly and safely to point of installation.

chanical and hydraulic compression connector tools, and epoxy resin splice kits are among other items that add quality to workmanship while lowering manhours.

*Buyers Are Impressed* when they see an electrical contractor arrive on the job with a good supply of power tools. Many of them consider electrical contracting a "hand tool" trade. Unless they see large tool equipment on the job site, they may continue to think that.

Many electrical contractors never consider the "prestige" effect of a well-tooled electrical project. Others give the subject a great deal of thought. Some contractors ship large quantities of tools to any sizable job. Some of the larger tools may be used very little, but they are there and available when needed. Some contractors paint their tools a distinct identifying color. The buyer is aware of the contractor's job tooling and forms an impression that the firm knows its business and has his (the buyer's) interest at heart.

Good job tooling has a positive psychological effect on the contractor's organization too. The morale of both management and employees is much better if they know that the firm is always prepared to carry on any work efficiently.



# Fluorescent and M-V Fixtures

One of the most controversial code subjects pertains to the status of electric-discharge lighting units, particularly for applications in industrial plants. Problems relate to branch-circuit voltage and ampere ratings; overcurrent protection of ballasts and accessibility of ballast overcurrent devices.

By J. H. Watt

THE wide use of electric-discharge lighting fixtures in industrial plants has brought to light a number of questions concerning NEC requirements. Some of these questions are:

1. What does the NEC mean by the term "electric-discharge" lighting units?

2. What branch-circuit ampere classifications are permitted for such units?

3. What is the maximum permitted voltage for such branch circuits?

4. Where fuses are used to protect ballasts, must they be "readily accessible"?

Questions such as these have been discussed recently by experienced contractors, consultants, and inspectors. After analyzing these discussions, it is clear that a "gap" exists between NEC rules and practices in the field.

As generally covered in this article, the scope of this subject applies to industrial plants. However, some of the points discussed could apply to commercial installations, especially remarks that are not based on the existence of qualified maintenance personnel.

In the 1959 NEC, there is no definition of an electric-discharge lighting unit although it is mentioned in Articles 210 and 410. However, the AIEE defines an electric-discharge lamp as follows: "An electric-discharge lamp is a lamp in which light is produced by the passage of electricity through

a metallic vapor or a gas enclosed in a tube or bulb." This definition should suffice for the two types of electric-discharge lighting units covered in this article; mercury-vapor and fluorescent fixtures.

While there are some electric-discharge lamps that contain a built-in resistor ballast, the discussions relating to fluorescent and mercury-vapor luminaires refer to auto-transformer, reactor or stabilizing type ballasts connected between the branch circuit and the lamps.

However, electric-discharge lamps with built-in resistor ballasts are installed in the same manner as incandescent lamps. Therefore, present code rules pertaining to the more common-type electric-discharge lamps that are supplied by non-integral ballasts, would not apply to the new type lamps. As a result, any new code definition of an electric-discharge lighting unit should include this distinction.

## Branch-Circuit Ampere Ratings

The NEC specifies what size branch circuits may supply various types of lighting fixtures, based mainly on types of lampholders used. See Fig. 1.

Section 210-24 reads: "Permissible Loads. Individual branch circuits may supply any loads. Branch circuits having two or more outlets may supply only loads as follows:

"(a) 12- and 20-Amp Branch Circuits. *Lighting units* and/or appliances.

"(b) 30-Amp Branch Circuits. *Fixed* lighting units with *heavy-duty* lampholders in other than dwelling occupancies.

"(c) 50-Amp Branch Circuits. *Fixed* lighting units with *heavy-duty* lampholders in other than dwelling occupancies.

Footnote: The term "fixed" as used in this section recognizes cord connections where otherwise permitted."

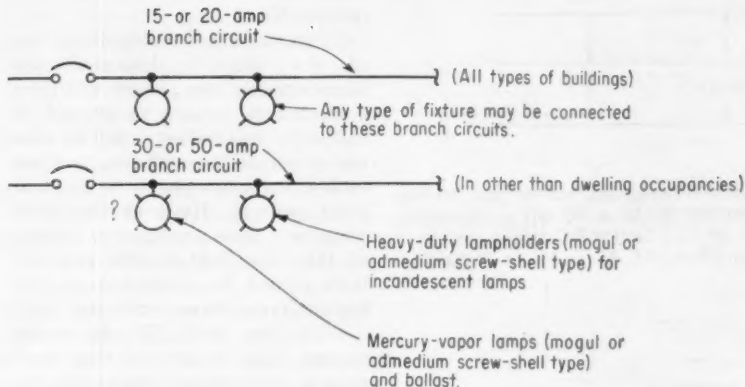
From the foregoing, there is no question that any type of lighting unit may be connected to 15- and 20-amp branch circuits. This is also verified in Table 210-25, where it is stated that *any type* of lampholder may be connected to 15- and 20-amp branch circuits.

On the other hand, there is no doubt as to the type of lampholders permitted on 30- and 50-amp branch circuits. With the term "fixed lighting units with heavy-duty lampholders" in Section 210-24 (b) and (c), there seems to be no other type of lampholder that is permitted on 30- and 50-amp branch circuits. In Section 210-8, heavy-duty lampholders are defined as: "Heavy-duty lampholders referred to in this Article shall include lampholders rated at not less than 750 watts. Exception: Admedium lampholders rated at 660 watts shall be considered to be heavy-duty type." This definition actually describes mogul and admedium lampholders that are used with incandescent and mercury-vapor lamps.

Because of the previously de-



## BRANCH CIRCUIT REQUIREMENTS (15 TO 50 AMPS) FOR LIGHTING UNITS



**FIG. 1**—Section 210-24 indicates the type of lampholders that may be connected to 15-, 20-, 30-, and 50-amp branch circuits. While mogul and admedium lampholders are used with many mercury-vapor luminaires, the connection of a ballast in at least one line to each lamp poses a question of code intent if used on 30- or 50-amp circuits.

scribed code requirements, most code authorities agree that fluorescent luminaires are restricted to 15- and 20-amp branch circuits.

But there is considerable difference of opinion about connecting mercury-vapor units (with mogul or admedium lamp bases) to 30- and 50-amp branch circuits. While most mercury-vapor lamps use the same mogul sockets as larger wattage incandescent lamps, some inspectors feel that because a ballast is interposed between a mercury-vapor lamp and at least one of the branch-circuit tap conductors, that this changes the picture. They feel that a mercury-vapor lamp ballast would have less protection on 30- and 50-amp circuits than on 15- and 20-amp circuits, if a partial ground occurs in an autotransformer or reactor winding.

But in defense of using mercury-vapor luminaires, on 30- and 50-amp branch circuits, engineers and contractors have this to say:

1. Many installations of mercury-vapor lighting units have been made in the past few years in industrial occupancies, where the units have been connected to 30- and 50-amp circuits without adverse results.

2. The vast majority of mercury-vapor ballasts are contained in enclosures that are designed for the purpose. And in actual installations, the ballasts are mounted so as to permit free circulation of air around them, which prevents overheating and resultant ballast failures.

3. Popular wattage ratings of mercury-vapor lamps are 400, 700, 1000, and 1500. With wattages of these sizes, it is advantageous to use the higher amperage branch circuits for economic reasons.

4. Existing 30- and 50-amp branch circuits supply mogul lampholders for incandescent lamps in industrial plants. Many of these fixtures are being replaced with mercury-vapor types. And in some instances, the existing incandescent fixture is utilized, and the M-V ballast is installed either at the original outlet or in the conduit stem to the fixture. To reduce these existing branch circuits to 15- and 20-amp ratings would create an undue hardship in trying to improve foot-candle intensities economically.

5. Many mercury-vapor units require starting currents higher than the normal operating current after the lamp has warmed up. This starting current must be taken into consideration when grouping units on a given circuit size. With a 15- or 20-amp circuit, the number of units will be greatly reduced, thereby requiring more such circuits than incandescent or fluorescent units of similar wattage totals.

### Branch-Circuit Voltages

For economic reasons, it is desirable to select higher voltage branch circuits for electric-discharge lighting units installed in many industrial plants. Ballasts for both fluorescent and mercury-vapor units are

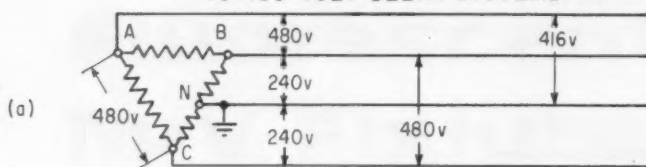
available for connection to branch circuits up to 480 volts.

Branch-circuit voltage limitations for electric-discharge lighting units are covered in Section 210-6 (a), Exception No. 2, which reads in part: "In industrial establishments . . . the voltage of branch circuits which supply only the ballast for electric-discharge lamps in permanently installed fixtures mounted not less than 8 ft from the floor, which do not have manual switch control as an integral part of the fixture shall not exceed 300 volts to ground."

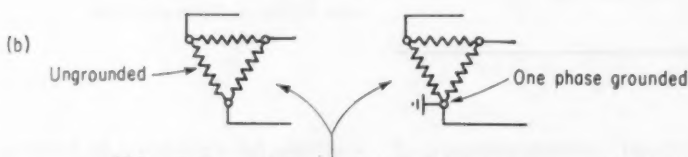
As a result of this code wording, the fundamental requirement is that the branch circuit supplying electric-discharge ballasts in industrial plants shall not exceed 300 volts to ground. There is no code rule that limits the phase-to-phase voltage of such circuits provided that any branch-circuit conductor does not exceed 300 volts to ground. With various 3-phase, 480-volt systems, this will vary according to transformer connections and grounding. Fig. 2 shows the various voltage combinations possible on 3-phase, 480-volt, delta supplies, and where electric-discharge ballasts may be connected.

However, to answer one question that is often asked, ballasts cannot be connected to the phase conductors of a 480-volt, 3-wire ungrounded delta system or where one phase conductor is grounded. In either instance the voltage-to-ground classification is 480 volts,

## CONNECTING ELECTRIC DISCHARGE FIXTURES TO 480-VOLT DELTA SYSTEMS



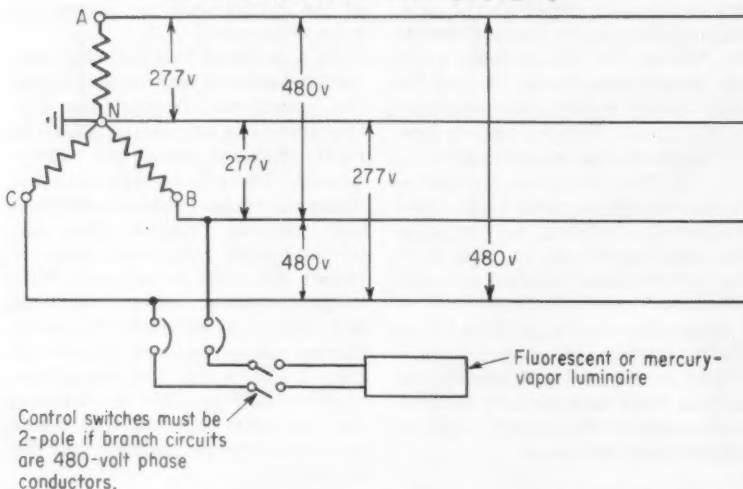
480-volt, delta system with midpoint of BC grounded. In other than dwelling occupancies, branch circuits tapped from BC, NC or NB may supply electric-discharge lighting units if installed per NEC Section 210-6(a) Exception No. 2. No fixtures can be connected across AB, AC or AN, as Phase A exceeds 300 volts to ground.



480-volt, 3-wire delta supplies. No fixtures can be connected to these sources, as in either case - voltage-to-ground (see definition Art. 100) ratings exceed 300 volts.

**FIG. 2**—Voltage-to-ground classifications of 480-volt delta systems depend on point of connection. In (a) of the above sketch, the midpoint of phases B and C is grounded. Thus phases B and C are less than 300 volts to ground. However, phase A exceeds 300 volts to ground and no fixtures can be connected to this phase. In (b) where the 480-volt delta is ungrounded or where one phase is grounded, the system exceeds 300 volts to ground.

## CONNECTING ELECTRIC DISCHARGE FIXTURES TO 480Y/277-VOLT SYSTEMS



Electric discharge lighting fixtures may be connected to AC, BC, CA, AN, BN or CN since no part of this system exceeds 300 volts to ground.

**FIG. 3**—With a grounded 480Y/277-volt supply as shown in the drawing, electric discharge-lighting units can be connected phase-to-phase or phase-to-ground as no part of this system exceeds 300 volts to ground. If branch-circuit conductors are phase-to-phase, control switches (not integral with a fixture) must simultaneously disconnect each ungrounded conductor.

following the definition of "voltage to ground" in Article 100 of the NEC. Because this connection exceeds 300 volts to ground, it is in violation of Section 210-6 (a), Exception No. 2.

By grounding the midpoint of one of the 480-volt delta-connected transformers, two phases will have a maximum voltage to ground of 240 volts, and ballasts may be connected across these phases, or from each of these two phases to the midpoint neutral. However the third phase will have a voltage to ground of 416 volts ( $240 \times 1.73$ ) and ballasts cannot be connected to this high-voltage phase conductor.

With the 480Y/277-volt 4-wire system (Fig. 3) in which the "wye" neutral connection is grounded, the voltage to ground is less than 300, and ballasts can be connected either phase-to-phase or phase-to-neutral. Ballasts are available for these 480- or 277-volt connections, and are listed by Underwriters Laboratories Inc.

However, it should be stressed that where ungrounded conductors (of a grounded system) supply electric-discharge ballasts, switching devices must disconnect all ungrounded branch-circuit conductors supplying the ballast to satisfy the provisions of Section 200-5.

## Ballast Protection

While neither the NEC nor UL requires overcurrent protective devices for each ballast, many designers specify such protection, particularly for fluorescent-lamp ballasts. No attempt is made here to compare types of overcurrent devices, such as fuses vs thermal devices, but rather to discuss actual questions that have arisen concerning code status when individual fuse protection is provided for each fluorescent ballast.

And it should be clearly understood that while separate overcurrent devices for each fluorescent ballast can aid in preventing fires, it cannot prevent ballast failures. Ballast failures generally occur because of poor maintenance procedures. The best method of preventing ballast failure is planned maintenance, including organized replacement of burned-out lamps and finally group replacement of lamps.

The most common question involves a rather general code rule, which in Section 240-16 (a) states

that overcurrent devices shall be located where they will be "readily accessible," except as provided in Section 230-91 for service equipment and Section 364-11 for busways. Literally applied, this code rule would exclude fuses (which are overcurrent devices) from being installed in fluorescent fixtures that are not "readily accessible." And most installed fluorescent fixtures with contained fuses could not be classified as "readily accessible" according to the definition given this term in Article 100, which reads: "Capable of being reached quickly, for operation, renewal, or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs etc."

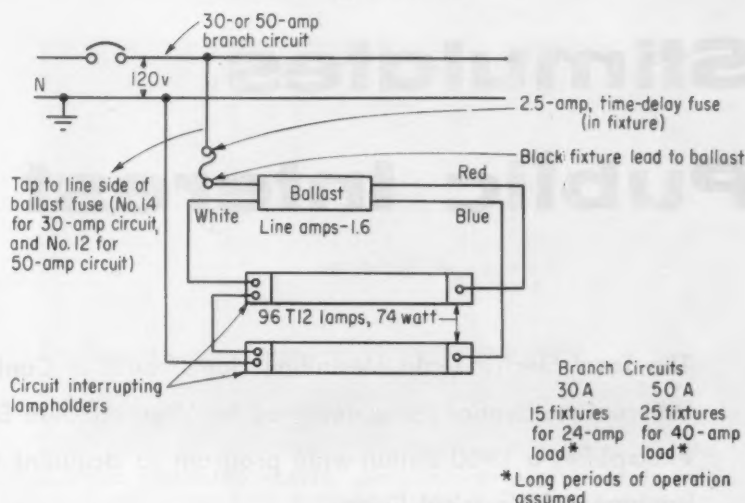
Fortunately, most inspectors recognize the advantage of *supplemental* protection for fluorescent ballasts, and overlook the literal wording of Section 240-16 (a). In addition, some code authorities feel that the provisions of this code rule apply *only* to overcurrent devices that are *required* in various parts of the code.

Conversely, many feel that in the interests of promoting uniformity and added protection that Section 240-16 (a) should include an exception, whereby *supplemental* overcurrent protection for unit equipment does not have to be readily accessible. This makes sense, and a code rule that in any way creates a barrier to the voluntary installation of *additional* overcurrent protection for individual equipment should be corrected.

Many engineers have felt a need for the recognition of 30- and 50-amp branch circuits for fluorescent luminaires installed in large industrial plants. While there has been little objection to the use of mercury-vapor lighting units on 30- and 50-amp branch circuits, there has been practically no recognition of fluorescent units containing *unprotected* ballasts on such circuits.

However, a number of large industrial plants with a competent maintenance staff have successfully used 30- and 50-amp branch circuits to supply fluorescent units where *each* ballast is provided with individual overcurrent protection. As shown in Fig. 4, taps (No. 14 for 30-amp circuits and No. 12 for 50-amp) run to the line side of the ballast overcurrent device. The overcurrent device, sized for the

## CONNECTING FLUORESCENT LUMINAIRES TO 30- AND 50-AMP BRANCH CIRCUITS— TYPICAL EXAMPLE



Note:

This arrangement is not recognized by the NEC, but is shown as a practical solution to grouping fluorescent luminaires on 30- and 50-amp branch circuits, in industrial plants having competent maintenance personnel.

**FIG. 4**—While the NEC does not recognize the connection of fluorescent luminaires to 30- or 50-amp branch circuits, the arrangement shown in the diagram has been successfully used in several large industrial plants. The basis of acceptance was that each ballast had a properly sized fuse and the plant involved had adequate maintenance personnel to assure the continued use of such overcurrent protection. With this arrangement, 15 two-lamp fixtures can be installed on 30-amp circuits and 25 such fixtures on 50-amp circuits.

particular ballast, protects the small fixture wire connected to the load side of the fuse.

In the event the branch-circuit contains two ungrounded conductors, two small overcurrent devices are used in each fixture.

Summarily, the branch-circuit overcurrent devices protect the circuit conductors and the ballast overcurrent device minimizes ballast fires and protects the fixture wire. With such an arrangement, a better coordinated overcurrent protection prevails than with *unprotected* ballasts connected to 15- or 20-amp branch circuits.

A NEC revision, recognizing that 30- and 50-amp branch circuits may supply fluorescent units that contain approved individual overcurrent devices for the protection of ballasts and fixture wire, would be in the interest of safety and good engineering practice. However, this practice should be restricted to industrial plants or similar occupan-

cies that have adequate maintenance personnel who can replace the smaller overcurrent devices.

### 40-Amp Circuits

Another problem directly related to this discussion pertains to the use of 40-amp branch circuits. The present NEC rules do not recognize such a circuit size, but instead, jump from a 30-amp branch-circuit size to 50 amps.

There appears to be no logical reason why a 40-amp lighting branch circuit should not be recognized, particularly where conductor tap sizes and types of lampholders are the same as permitted on 50-amp circuits. And in the interest of economy, No. 8 conductors will cost less than No. 6 conductors, and at the same time will provide additional latitude for the designer. Also, 40-amp overcurrent devices offer better protection than 50-amp devices.

# Total Electric Home Stimulates Public Interest

The Total Electric Gold Medallion Home, built in Canton, Ohio, is one of 15 different residential plans designed for Westinghouse Electric Corp. This home exemplifies a 1960 nation-wide program to acquaint the public with the advantages of electrical living.

**B**LEND new architectural ideas with the latest in electrical equipment and techniques and you stimulate desire on the part of prospective home buyers. Such was the case with the Westinghouse Total Electric Home built in Canton, Ohio. More than 30,000 persons visited the model home during a 30-day open house. Moreover, this is the same home featured on spot TV commercials during the political conventions and the national election during 1960.

John Morse, architect of the firm of Bassetti and Morse, Seattle, Wash., designed the Westinghouse Total Gold Medallion Home No. 2 in Canton.

J. R. Wilkin of Canton was the builder. And Wharton Electric of Canton did the electrical installation, which featured a full 200-amp service with 42 circuits; electric baseboard heaters totaling 17.5 kw; full indoor and outdoor lighting treatments; complete built-in electrical cooking and exhaust equipment; and a central air-conditioning system.

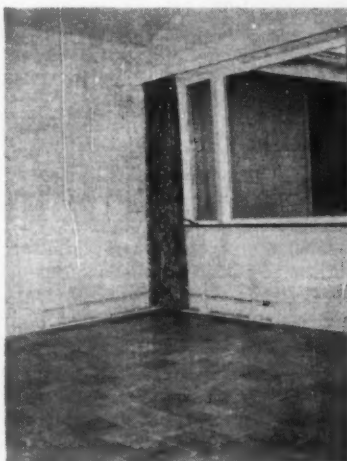
A whimsical but practical "crow's nest" is one of the home's many attractive architectural highlights. Located over the family room wing and accessible by stairs, the space can serve as a youngster's hideout and play area or as a child's extra bedroom.

Elsewhere, the unique floor plan allows the separation of indoor living areas and maximum privacy for outdoor living. And, in all areas, electric convenience is present.

## Electrical Service

Full 200-amp capacity service-entrance conductors terminate in a main 200-amp CB, which controls 42 branch circuits located in a small

closet just off the laundry center area. Ten 2-pole branch circuit breakers supply the electric heater loads. Other 2-pole CBs handle 230-volt appliances such as the water heater, clothes dryer, central air-conditioner unit, built-in oven, and cook top. The remainder of circuits supply 115-volt receptacles and lighting with a small number of outlets on each circuit to minimize circuit overloading.



**CORNER ELECTRIC HEATERS** are typical of baseboards units, which total 17.5 kw in 1587-sq-ft Total Electric Home wired by Wharton Electric Co., Canton, Ohio. Units in each room have built-in thermostat control.

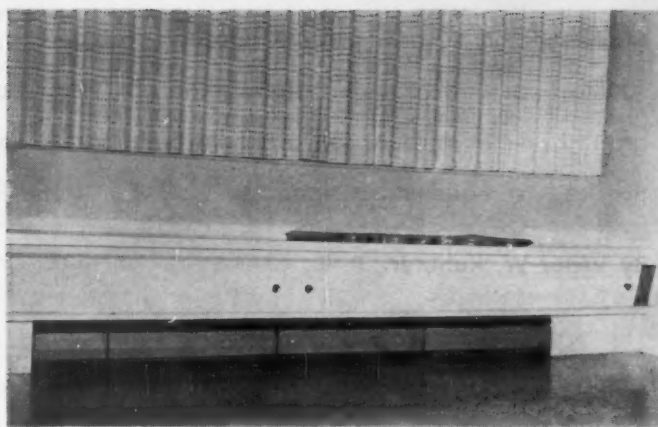


**J. R. WILKIN**, builder of the Canton, Ohio Total Electric Home holds open swinging doors to laundry room, located just off family room. Stairway leads to a "crow's nest" play area or extra bedroom for children.





**ELECTRIC BARBEQUE UNIT** includes motorized spit and pushbutton exhaust hood. Unit faces dining room area. In the background, built-in refrigerator and dishwasher can be seen. Two-way wall bracket lights supplement under-counter sink lighting in unique food preparation center.



**ELECTRIC BASEBOARD HEATER**, with built-in thermostat, is neatly installed under window bench in the dining room of Total Electric Home in Canton, Ohio.

### Lighting Features

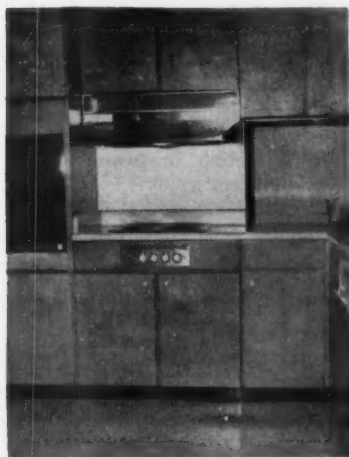
Well-planned lighting presents a reversal of form prevalent in the last few years. Instead of relying on portable lamps plugged into switched convenience outlets for lighting in several rooms, every room has fixed lighting in the form of ceiling, bracket or valance lighting, or in some instances, a combination of several such units. Ex-

terior lighting consists of a post lantern, eave "spots," and well-lighted breezeway and car port areas. In addition, outdoor receptacles are provided for accenting landscape features by plug-in spot luminaires.

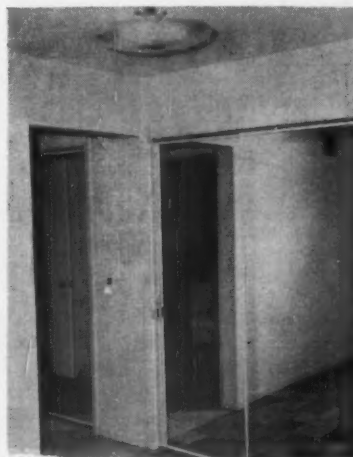
In bedroom No. 1 (shown in accompanying photo) the ceiling fixture is mounted off center and is located close to full-mirrored, double closet doors. In this way, much better area lighting prevails.

And, of course, multiple switching lights the way throughout the indoor and outdoor areas. The dining room ceiling fixture is controlled by a dimmer switch, which provides the level of light to suit the occasion. All closets are equipped with lights, some controlled by automatic door switches.

For heating the home, 17.5 kw of electric baseboard heaters are (Continued on page 177)



**KITCHEN AREA** includes built-in electric oven and cook top with light-equipped, ventilating hood. Kitchen electrical appliances are arranged in an L-shaped alignment to provide maximum convenience and working space.



**BEDROOM No. 1** features offset ceiling fixture located near fully mirrored double closet doors to provide more efficient lighting at this area. Ceiling bracket or valance lighting in one or more forms are installed in each room.



**CENTRAL AIR CONDITIONING** unit is located in compact basement space. Unit contains Precipitron control and cools, cleans, dehumidifies, circulates and ventilates, as required. Counter-top electric water heater is shown at left of photo.

# Powering a Multi-Building School

Multi-building schools present unusual problems to electrical system designers. At Madeira Beach Junior High School, St. Petersburg, Fla., a 480-volt underground system supplies ten separate buildings. Proper voltage level selection is the key to optimum design.

By Victor W. Kuhl, Jr., P. E., Consulting Engineer, St. Petersburg, Fla.

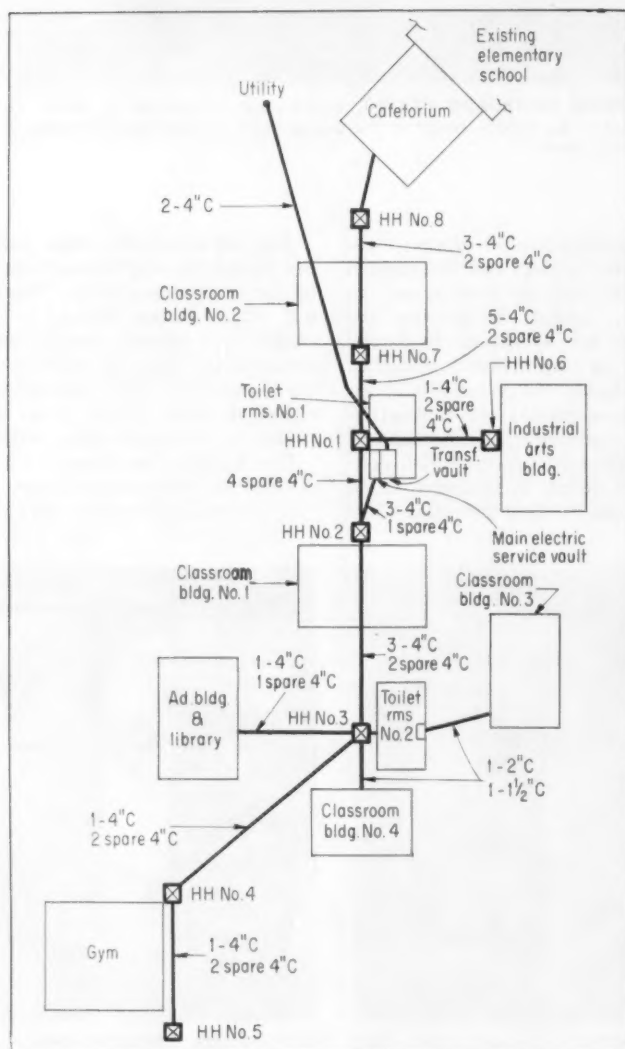


FIG. 1—Plot plan of Madeira Beach Junior High School shows concrete encased, underground power distribution to various buildings. TV cable in a separate metallic conduit is included in the concrete envelope. For future expansion, spare fiber conduits are installed.

WHEN designing an electrical system to serve comparatively distant buildings, particular care must be taken or costs may skyrocket. Of paramount importance is the selection of proper voltage levels.

Fig. 1 shows the plot plan for the Madeira Junior High School, St. Petersburg, Fla. Ten separate buildings are 75 to 100 ft apart. Main electric service is from a basement vault in the toilet room building No. 1. This location was chosen because it is nearest to the heaviest electrical loads. Farthest points to feed are the gymnasium—about 500 ft distant, and the cafetorium—260 ft away.

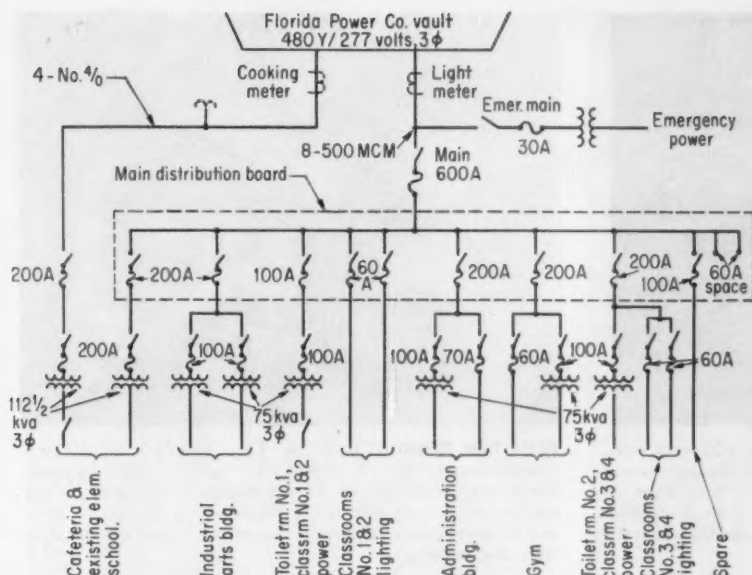
While most schools have a 208Y/120-volt service, these long runs indicated the use of a higher voltage. Since 480Y/277 volts was readily available, we compared costs of a 480-volt system to costs of a 208-volt system. And, after studying the system requirements, it was evident that the 480-volt system would effect substantial savings. Deciding factors in favor of the 480-volt system are:

- (1) Load make-up—at least one-third of the load could utilize 480-volts or 277 volts.

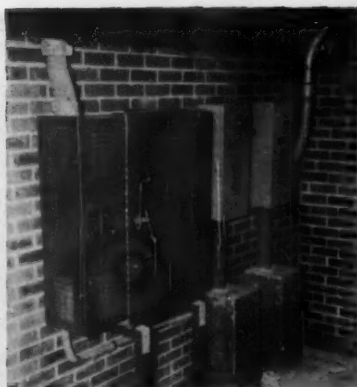
- (2) Load magnitude—total load was at least 200 kva with primary service available.

- (3) Length of feeders—feeders averaged at least 200 ft in length.

The higher cost of the 208-volt system is due mainly to the larger main service and larger feeders and panels which are needed to handle the high currents. On the other hand, the savings obtained with the 480-volt system far outweigh the cost of the required step-down



**FIG. 2**—Distribution system for Madeira Beach Junior High School. Emergency power is connected ahead of the main switch. Current-limiting fuses, mounted in the main distribution board, protect building feeders. Cafeteria kitchen is metered separately. Practically all lighting is supplied at 277 volts.



**RACK-MOUNTED**, this 75-kva, 480 to 208Y/120, 3-phase transformer supplies power for receptacles and miscellaneous equipment. To the right of the transformers are two 100-amp, fused switches. One is a disconnect switch for the transformer; the other is a main switch for a 277-volt lighting panel. On the left side of the transformer is the ventilated, terminal compartment. From here, the secondary conductors are carried through a flexible conduit and into a wireway to branch distribution panelboards.

transformers. Actual savings amounted to 17% of the contract. And these savings were obtained with the installation of the more flexible 480-volt system.

480Y/277-volt feeders from the main distribution board extend in underground duct to all buildings. Power is fed through a 600-amp main switch except for the cafeteria kitchen which is fed separately through a 200-amp switch. Current-limiting fuses are installed in the main switch and in the building feeders at the main distribution board. Note, that at 480 volts, the 500-kva load required a 600-amp main switch. At 208 volts, a 1600-amp main switch would have been required to handle 1395 amps.

We selected an underground system to supply power to the ten school buildings. Bituminous fiber conduit encased in concrete is used for power and signal raceways with field-constructed concrete handholes installed at strategic locations. During installation, wire can be pulled at handholes and later, wire and cable may be inspected or replaced. For a future closed-circuit TV system, a rigid metal conduit system is also provided.

A central grounding system is utilized. A separate ground conductor connects the power company neutral, the water system, the

ground electrode in each handhole, each transformer, and each metallic conduit system at each building.

Fluorescent lighting is supplied at 277 volts, fed from 3-phase, 4-wire lighting panels in each building. Three-phase dry-type transformers provide 208Y/120 volts for incandescent hall lighting, receptacles and miscellaneous equipment.

A low-voltage, remote-control system controls the large-area fluorescent lighting of the gym and the industrial arts building. Low-voltage 9-position switches, centrally located, operate ganged 277-volt relays, which are connected to control the lights.

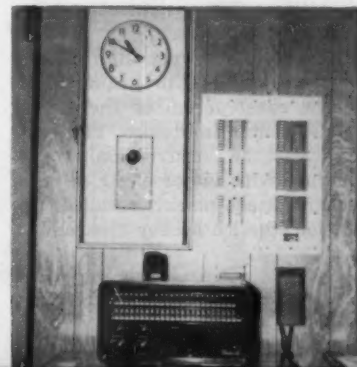
**CONCRETE HANDHOLE** shows fiber conduit, rigid metal conduit and ground conductor. Handholes, strategically located, facilitate installation and maintenance of the system. Metallic conduit, for closed-circuit TV, reduces interference from adjacent power lines.

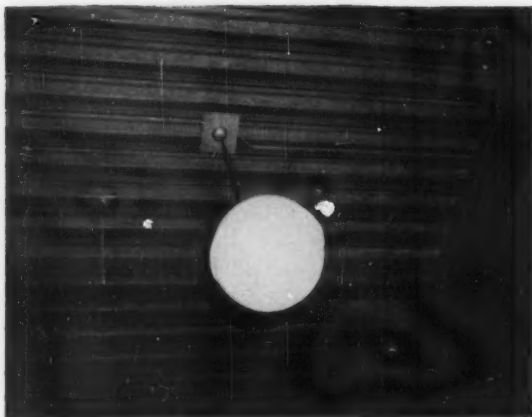


A complete 2-way sound system extends from the administration building to each classroom or activity area. Separate call and return may be made to each location or an all-points call may be used. In addition to this, a separate emergency alarm system is installed with remote call stations and with emergency horns located for the best sound coverage of the respective areas.

C. Dale Dykema, St. Petersburg, was the architect; Victor W. Kuhl, Jr. & Associates were the consulting engineers; and Gabrio Electric Company, St. Petersburg, was the electrical contractor.

**SOUND-SYSTEM CENTER** is exemplary of the modern decor throughout the school. From the console, 2-way calls may be made to each building or an all points call may be used. In addition, the center controls time signals, programing and is the heart of the emergency alarm system.





**PIPE-SUSPENDED LUMINAIRE** consists of a 400-watt mercury-vapor lamp, enclosed in a "satellite" frosted-plastic bowl, and is typical of nine such fixtures in the entrance foyer of Colgate University's William A. Reid Athletic Center. Square metal plate conceals outlet box behind fixture canopy. Ballasts are remotely located.



**FOUR 1-IN. CONDUITS** contain 12 two-wire 460-volt, 20-amp branch circuits for 72 1000-watt, high-bay, mercury-vapor luminaires, which provide 80 maintained footcandles on the ice hockey skating rink below. Connecting ballasts to 460-volt phase-to-phase conductors, saved considerable expense in labor and material.

*For lighting and power loads*

## College Athletic Center Uses 460Y/265 Volts

Designing 460- and 265-volt lighting in addition to using 460 volts for 3-phase motors, provided substantial savings and spare capacity for future anticipated loads at Colgate University's William A. Reid Athletic Center.

**I**NITIAL planning of the electrical system for Colgate University's William A. Reid Athletic Center, Hamilton, N. Y., included considerations for present and future loads as well as the selection of efficient low-cost equipment and installation techniques.

Because of budget limitations, Colgate's building program called for the construction of their new athletic center in stages. The first stage was the construction of the structure with major electrical and mechanical equipment installed. In addition, the ice hockey rink and a

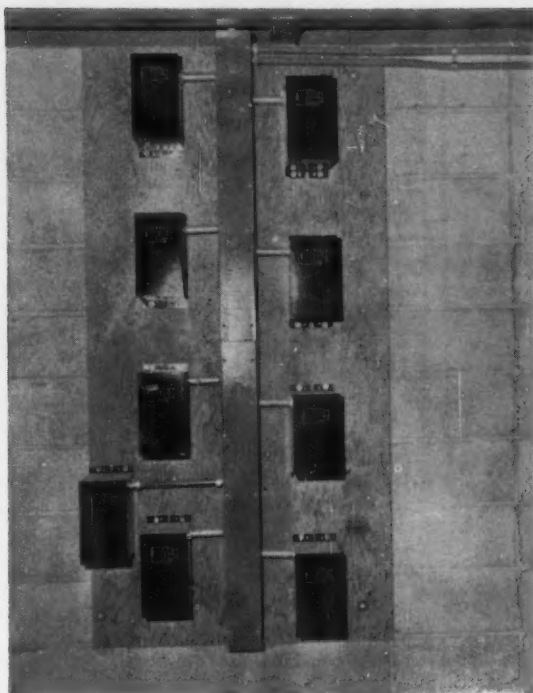
6-lane bowling alley were completed. Future construction stages will include a gymnasium for basketball and other indoor sports as funds are appropriated.

From the beginning, all those concerned with the electrical design realized that long-term savings could be effected by installing full service, feeder, and panelboard capacities during the first stage of construction. Even though only partial loads were to be used at the start, appreciable savings would result later on.

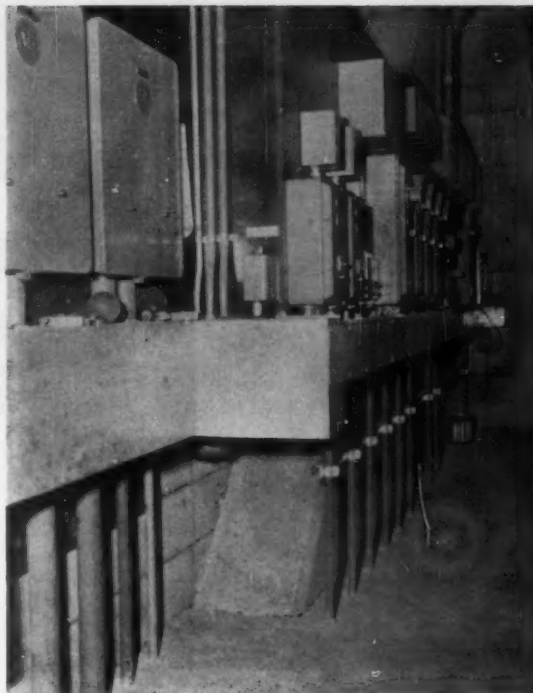
One of the major considerations

was the choice of lighting, particularly for the ice hockey rink. Knowing that many ice hockey rinks are poorly lighted, college officials and consultants decided to take advantage of the latest lighting equipment and techniques. And since a 460Y/265-volt system was previously determined due to a large 3-phase motor load, attention focused on a lighting system, which could be used at these voltages. The choice was 1000-watt mercury-vapor luminaires, and 72 of these units, installed in four rows in the high-bay arched ceiling, provided





**MERCURY-VAPOR BALLASTS** for 400-watt luminaires (shown in an accompanying photo) are located in a loft room adjacent to foyer lighting area. Vertical gutter between ballasts contains line and load conductors.



**CUSTOM-MADE GUTTER**, designed by Kogut Electric Co., Utica, N. Y., fits contour of offset wall. Notice the capped gutter elbow in the background, which was installed to simplify additional trough at a later date.

about 80 maintained footcandles on the ice-hockey playing surface below.

Because the fixture ballasts are connected to the 460-volt phase-to-phase conductors of the 4-wire grounded neutral system, the current to each 1000-watt luminaire is only 2.1 amps. As a result, each 2-wire 20-amp branch circuit supplies six 1000-watt lamps. And since 18 lamps are in each of four rows, a 1-in. conduit easily accommodated three branch circuits per row. At the same time, this loaded each branch circuit to about only 60% of its capacity. This derating kept voltage drop to a minimum. Another factor was that the additional circuit capacity could handle the higher starting currents that exist when starting the lamps cold. And limiting long home runs to four 1-in. conduits provided substantial labor and material savings.

In the entry foyer, nine 400-watt mercury-vapor lamps are each enclosed in a "satellite," frosted-plastic bowl (as shown in an accompanying photo), and are pipe-suspended from a metal corrugated ceiling. These luminaires have 277-volt ballasts. And they are remotely

located in a loft room adjacent to the foyer area. The elimination of the ballast from the fixture provided a much neater appearance.



**SECONDARY MAIN SWITCH** for 460Y/265-volt supply consists of 800-amp pressure-bolted contacts and high-interrupting capacity fuses. Lower compartment is for power company's CTs. A 75-kva dry-type transformer to the left of the main switch provides 208Y/120 volts for small motors, convenience outlets and other 120-volt equipment.

In the bowling alley, ticket booth and entrance, fluorescent ballasts are the rapid-start types, integral with each fixture, and rated at 277 volts.

### Service Equipment

Primary service at 4160 volts, 3-phase enters a transformer room, located on one outside wall of the building, and supplies three 250-kva transformers. By the use of askarel-filled transformers, a costly code-type transformer vault was avoided.

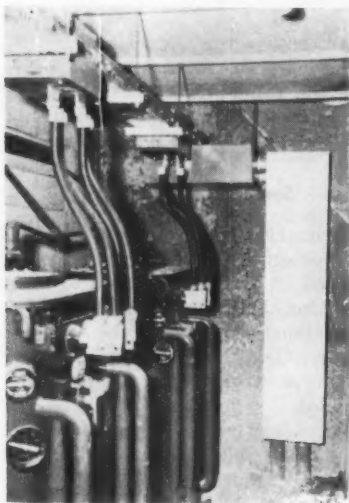
Secondary service conductors at 460Y/265 volts, 4-wire, 3-phase with a grounded neutral, connect to an overhead 800-amp busway above the transformers (see accompanying photo). From there, the busway terminates into a pull box, where two 3½-in. conduits, each containing three 500 MCM and one 3/0 conductors, extend underground to the 800-amp main switch in the centrally located equipment room. The 800-amp switch is the pressure-bolted type, containing high-interrupting capacity fuses, and a compartment for the power company's current transformers.



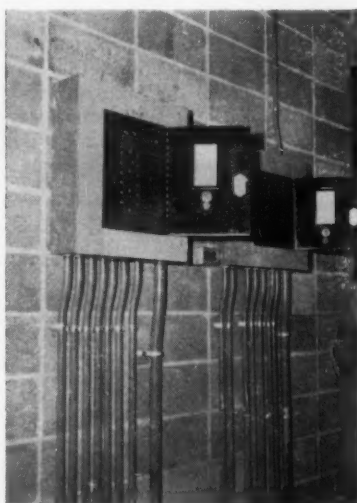
**PETE KOGUT**, owner of Kogut Electric Co., Utica, N. Y., displays 460-volt service switch, dry-type transformer, separate meter, and panelboard for 120-volt emergency lighting equipment. Emergency service switch is connected ahead of building's 800-amp main switch.



**LIMITED SPACE** between magnetic starters required stacking of conduit runs entering auxiliary gutter. Pete Kogut points to channel supports and straps used to fasten this unusual conduit arrangement, which permitted closer spacing of starters and other equipment.



**TRANSFORMER ROOM** on the outside wall of Colgate's William A. Reid Athletic Center contains three 250-kva, askarel-filled transformers. Transformation is from 4160 volts to 460Y/265 volts. Secondary jumpers provide connections from transformer terminals to overhead 800-amp busway. Busway runs to a horizontal pull box, which in turn feeds a vertical pull box, where two 3½-in. conduits extend underground to 800-amp main switch. Conductors in each conduit consist of three 500 MCM and one 1/0. Transformer room is well ventilated with front and side wall louvers.



**SURFACE PANELBOARDS** are typical of those installed throughout the William A. Reid Athletic Center at Colgate University. Panel on the left contains circuits for 460Y/265-volt loads and panel on the right handles 208Y/120-volt circuits.

Power distribution panelboards for the 460-volt supply are connected to the 800-amp switch. Five, 3-pole, feeder circuit breakers supply branch-circuit power panelboards in other parts of the build-

ing. One 460-volt feeder serves a 75-kva dry-type transformer, which provides a 208Y/120-volt source for single-phase motors, convenience outlets and other 120-volt equipment.

For the 120-volt emergency lighting, a separate dry-type transformer is connected ahead of the main 460-volt service switch.

Pete Kogut, owner of Kogut Electric Co., Utica, N. Y., electrical contractors for this project, contributed some of his ideas on the initial installation to simplify additions to the wiring when other areas of the buildings are to be completed.

An accompanying photo shows a custom-made gutter Kogut designed to fit offset wall configurations. And at the far end of the gutter, he provided a capped corner elbow so that additional gutter trough can be added easily, later on. The gutters are used to distribute wiring for combination CB/magnetic motor starters.

Oscar F. Wiggins of New York City was the architect for the athletic center; with Raymond J. Rice serving as the mechanical engineer. General contractors were Barr and Barr, Inc., New York City.

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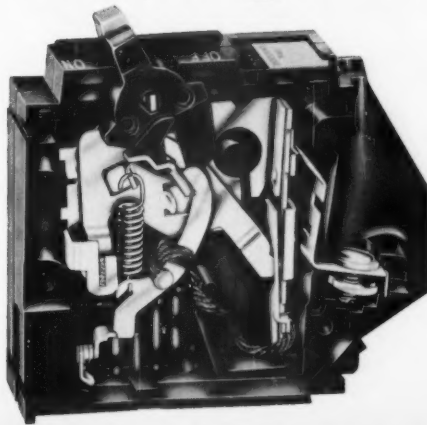
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# Bare Hands Work Hot Lines

New method for handling live conductors on high-voltage transmission lines provides greater safety for linemen and reduces labor costs.

**I**MAGINE working on a 138,000-volt transmission line with your bare hands.

It's being done today, in safety, by linemen of the American Electric Power System, including Ohio Power Co., thanks to a new twist on an old idea borrowed from the birds.

The revolutionary new technique of working with bare hands on an energized power line, now thoroughly field tested and about to be adopted as standard practice on AEP System lines, was announced by AEP and Ohio Power President Philip Sporn. He described the method as "a truly outstanding development, one of the most important in its field in the history of the electric power industry," but warned that its use required special equipment and proper training to insure the linemen's safety.



**IN A PRECEDENT-SETTING** operation, linemen for the first time work with bare hands on an energized 138,000-volt line near Findlay, Ohio. They stand in a non-conducting fiberglass bucket supported by an insulated boom. The new technique was developed by the American Electric Power System for maintenance work on its 76,000 miles of transmission and distribution lines.

Mr. Sporn disclosed that the new method for handling live conductors with bare hands had been thoroughly lab-tested at voltages up to 380,000 volts and also had been proved safe during extensive field tests.

Field tests were recently carried out on both a 138,000-volt steel tower transmission line and a 34,500-volt wood pole transmission line in the Findlay District of Ohio Power Co., an AEP System operating utility, by an Ohio Power crew. Numerous engineering, operating and safety officials, assembled from various points on the seven-state AEP System, witnessed the tests.

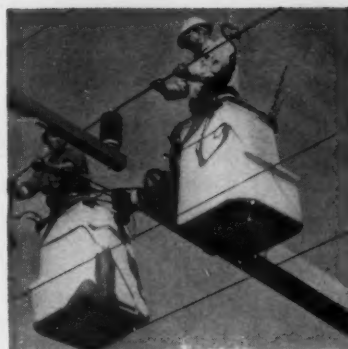
The new technique is a simple one. It is the reverse of conventional practice and utilizes the principle that current does not flow when there is no difference in voltage between two points. In the past, a lineman has performed his work while grounded, being insulated from the live conductor by protective devices such as rubber goods and insulated "hotsticks." With the new method, the lineman is charged at the same voltage as the line on which he is working—a phenomenon of which he is not even physically aware—and he is protected from ground by effective insulation.

It is the same way with birds. They can perch on high-voltage lines with nonchalance because they are not in contact with the ground. When they roost on a wire, they merely become charged or energized to the voltage of the line itself, and in this process they are not even hurt.

In emphasizing the significance of the development, Mr. Sporn pointed out four major benefits:

(1) Further improvement of today's reliable electric service to customers by insuring service continuity through eliminating interruptions for line repairs.

(2) Reduced line maintenance



**WORKING BARE-HANDED** on a live wire, linemen repair a 34,500-volt line near North Baltimore, Ohio. Left to right are T. A. Roberson, transmission tester and inspector, and L. H. White, general transmission inspector.



**BUCKET RIG** is mounted on a truck and can be used for line repair work everywhere but on the roughest ground. Above, linemen safely change an insulator on an energized 34,500-volt line.

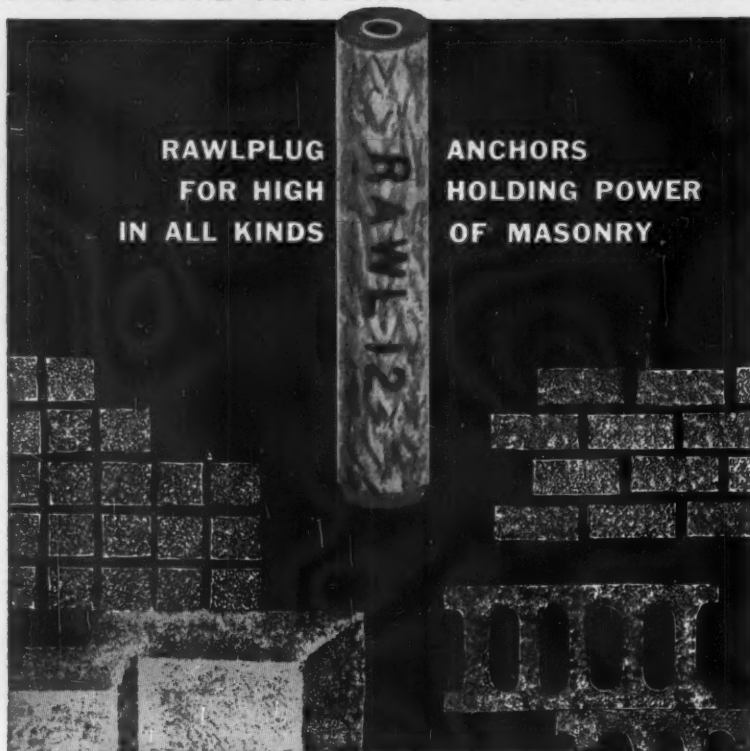
costs brought about by savings in both time and manpower.

(3) Simplified working conditions, permitting linemen to work without cumbersome tools and equipment.

(4) Greater safety in many cases than with the use of live line tools in conventional practice.

Here's how the new method works. Linemen work while standing in a fiberglass bucket hoisted to overhead wires by a truck-mounted insulated aerial boom. The bucket is lined with a metal mesh that is connected by clamps to the conductor on which the men are working, thus energizing the screen and the occupants at the same voltage as the line. Their safety is provided by the insulated boom which protects them from the difference

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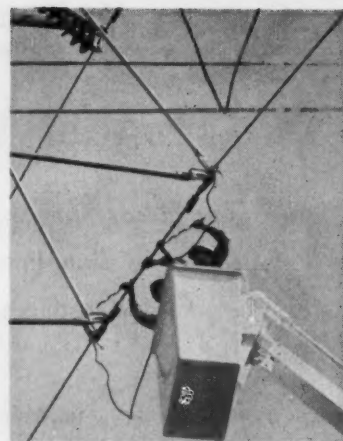
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**LINEMEN REPAIR** a "hot" 138,000-volt transmission line using a combination of "hotsticks" and their bare hands. Protected by the insulation from the difference in voltage between the ground and the wire, the men are charged at line voltage by connecting the metal mesh lining of the bucket to the conductor.

in voltage between the ground and the live conductor.

Harold L. Rorden, high-voltage practices engineer for the American Electric Power Service Corp., New York, developed the basic idea and supervised the research and testing. He was assisted in the development work by Merle L. Fisher, of Canton, transmission superintendent of Ohio Power.

Holan Corp., Cleveland, manufacturer of hydraulic derrick trucks and aerial lifts, and its parent company, Ohio Brass Co., cooperated in the tests and supplied equipment. The lab work was carried out in the Ohio Brass high-voltage laboratory at Barberton.

This new equipment is a real boon to linemen. For years they have worked on hot wires with hotsticks while hanging from wooden poles or steel towers by their safety belts. It was a difficult job made more difficult by cumbersome working procedures, which were necessary for safety. Now linemen can stand in front of the line and work comfortably on it with their bare hands or wearing ordinary work gloves.

Savings in time will be major. For example, in conventional line work and under ideal conditions, approximately five manhours are required to change an insulator on a 34,500-volt wood pole line. With the new method, this same job takes but half a manhour.

Industry experts predict a new era in simplifying and speeding up the process of working hot lines.





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the  
one  
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Shown here unplated.

The other one is ordinary EMT that failed early in a pressure test. CIRTUBE EMT held up far beyond UL requirements. The reason: *continuous induction welding*, by far the best technique for making *bead-free, split-free* welds on high quality EMT.

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Ask for it on your next job—you'll like working with it.



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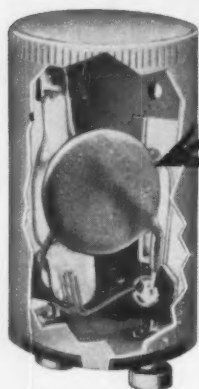
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## Rotating Luminaires Solve "Tunnel" Problem

A fuselage assembly area in an aircraft plant has a unique lighting problem, for in spite of good *general* illumination within the building, people working inside a plane's framework are in effect working in a tunnel devoid of built-in illumination. This creates an obvious need for local lighting; a problem solved at Rohr Aircraft's southern California plant by means of portable luminaires that can be rotated a full 360 degrees.

Lighting units consist of two 2-lamp 4-ft fluorescent fixtures mounted in parallel and supported by a common frame. The frame in turn is mounted on a horizontal pipe shaft that can be rotated manually to any desired degree, then locked in that position by means of threaded hubs and pressure-exerting twist-knobs located atop the two end sleeves. Framework supporting the entire assembly is constructed from pipe sections welded together as shown, while rubber-tired casters permit easy positioning of fixtures.

Expanded-metal panels protect lamps from breakage, while flexible rubber-sheathed extension cables and twist-lock connection plugs permit freedom of movement for these practical lighting mediums.



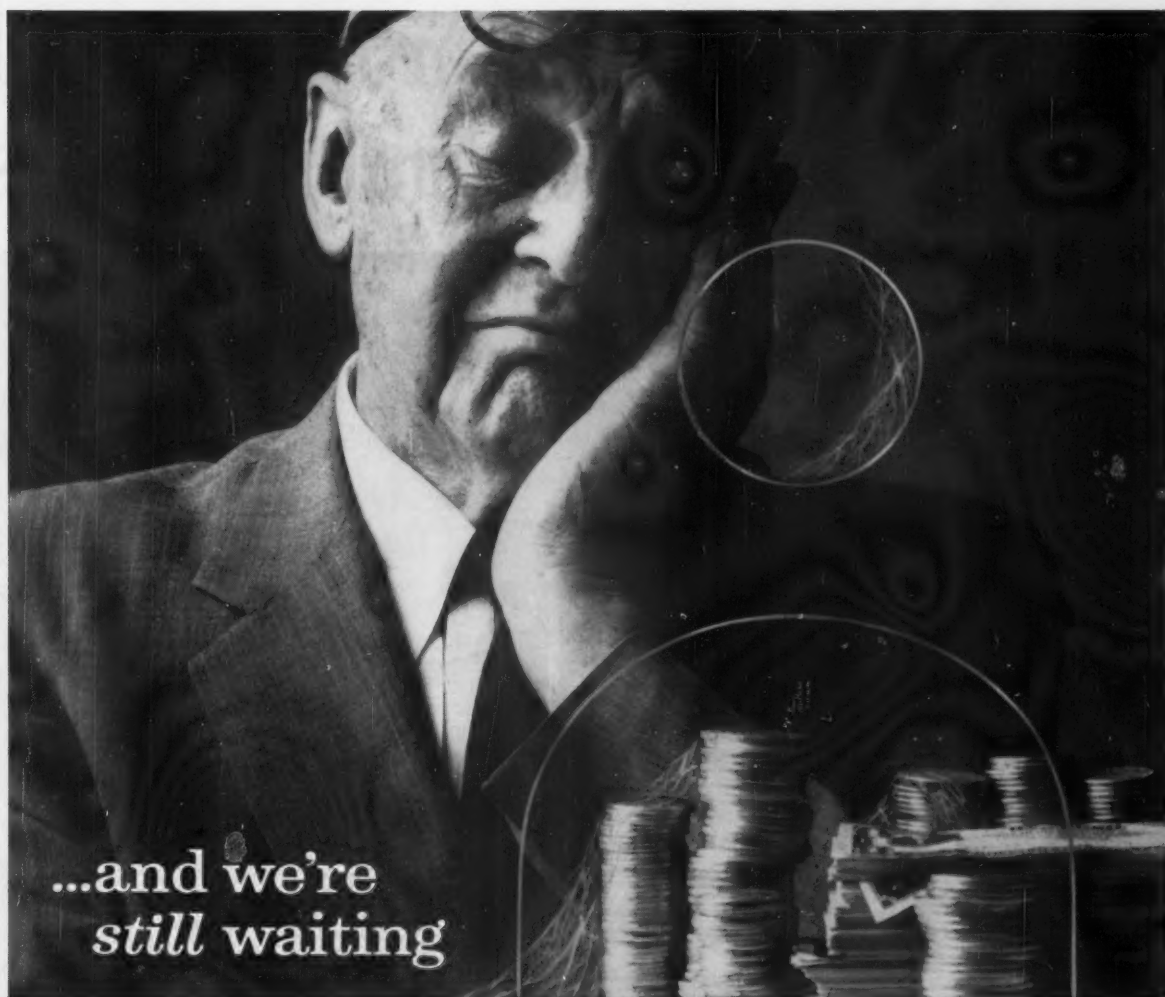
**MOVABLE, CASTERED STAND** for horizontally rotating 4-lamp luminaire permits high-level illumination to be directed towards local work areas inside fuselage at aircraft assembly plant located in southern California.

Illumination levels naturally vary with curvature of fuselage surfaces, distances between fixtures and areas of seeing tasks, and with angle of light incidence. In the fairly typical application shown in this illustration, however, light-levels at task-points were measured as high as 150-fc.

Units were designed and constructed by Rohr engineering personnel at a cost of approximately \$90 per unit.

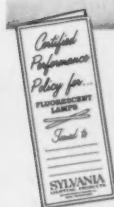


**MOTORIZED DATA HUB** provides finger-tip access to parts catalogs at specially designed six-station order desk recently installed in the Chicago warehouse of the Complete-Reading Electric Company. Lazy Susan type shelf is pushbutton controlled by men at stations. Newest type phone hookup, an automatic switchboard for inter-warehouse communications and a pneumatic tube system ties order center to all departments. Complete-Reading expects a 30% speed up in phone-order handling and mail-order processing when new installation is fully integrated into the company operations.



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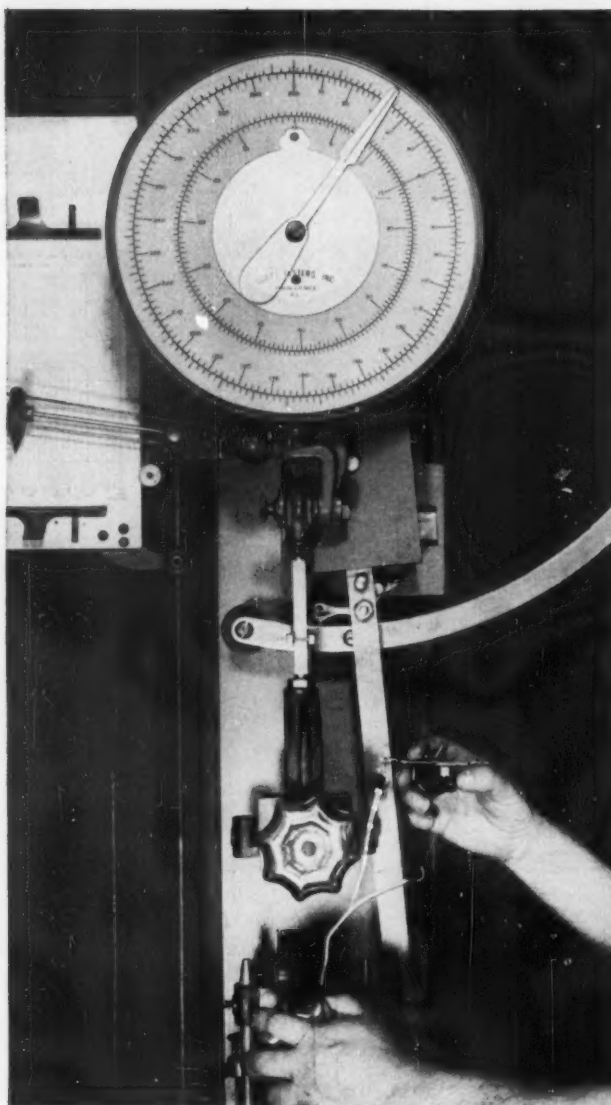
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ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . JANUARY, 1961

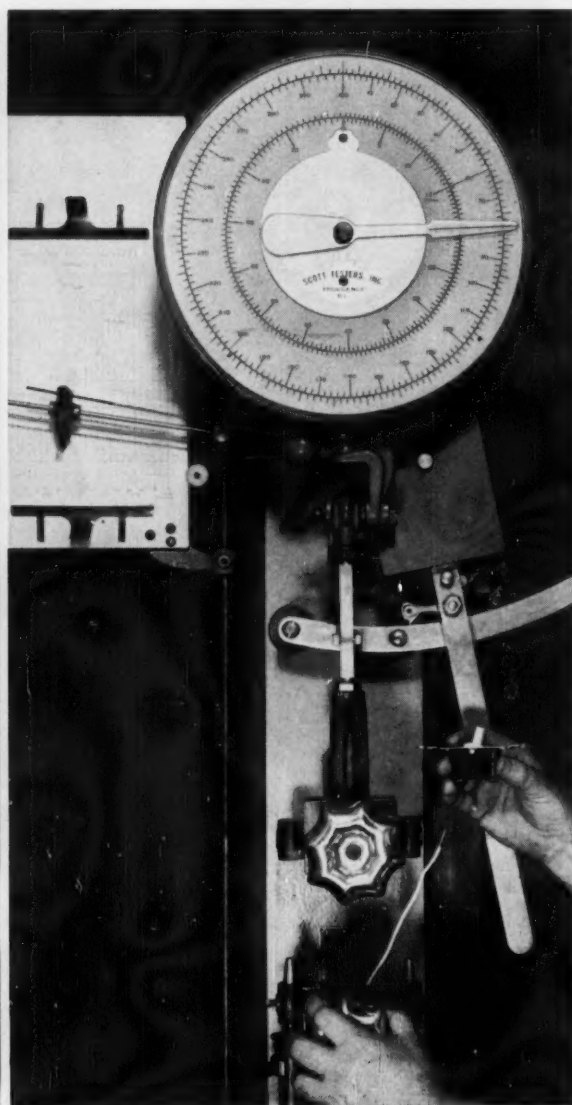
103



# Laboratory tests prove General make better connections



- 1. Better mechanical connections** — This testing machine shows that a wire can be pulled out of an average binding screw connection (in left photo) by a force of about 30



pounds. Yet a G-E Pressure-Lock\* terminal (in right photo) is good for 80 pounds! You can see the tight Pressure-Lock grip is more than adequate for any wiring job.

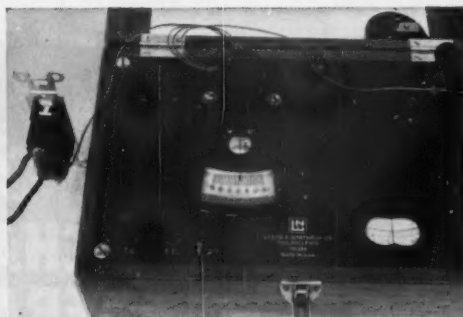
General Electric recommends its 135 switches, outlets and lampholders with Pressure-Lock terminals for the most modern, tight wire connections. Of course, it offers a complete line of wiring devices with binding-screw and clamp-type terminals, too.

Ask your General Electric distributor to show you the many new ideas — the extra-quality features and the wide choice of wiring devices that you get in the complete G-E line. General Electric Company, Wiring Device Department, Providence 7, Rhode Island.

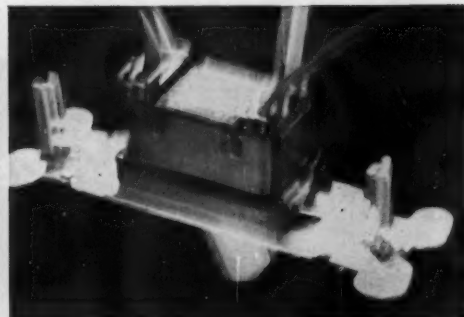
\*Registered trade-mark of General Electric Company



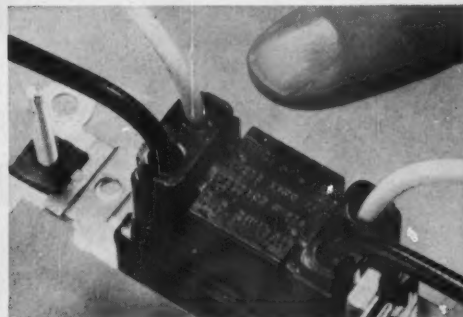
# Electric Pressure-Lock Terminals than binding screws!



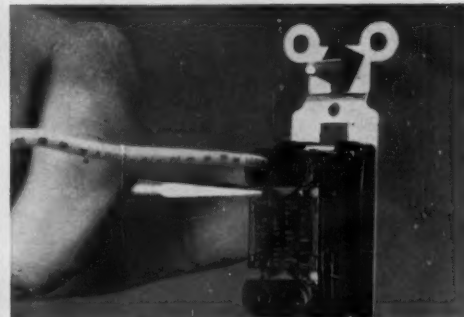
**2. Better electrical connections** — The temperature rise in a Pressure-Lock connection carrying 15 amperes is only 8°C — way below the U. L. allowed limit of 30°C! Humidity and salt do not affect this fine connection.



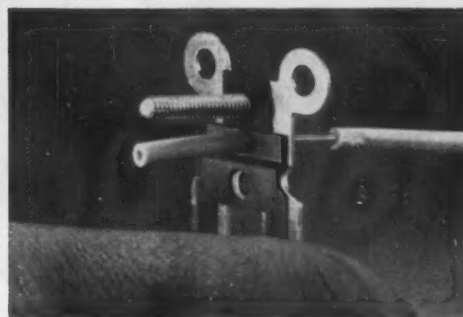
**3. Longer-lasting connections** — Pressure-Lock connections won't loosen under temperature changes or vibration the way screws do. And of course there is never any trouble with stripped threads, either.



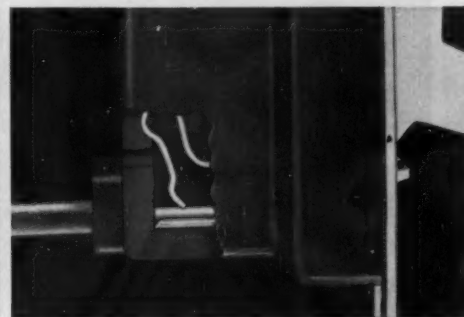
**4. Extra safety** — Notice that back-wired Pressure-Lock terminals are totally enclosed, to protect against grounds and shorts. And, they don't bend or loosen when you press the device back into a box.



**5. Easy release when desired** — New, wide release slots permit convenient release of wires by pressing with regular-sized screwdriver. They also make handy contact points for ring-out testing.



**6. Built-in wire stripper** — Yours on several of the most-used G-E Pressure-Lock devices, at no extra cost. You just push a wire into a hole in the strap and pull out. A little steel blade strips it clean.



**7. Quality design** — A strong, steel locking spring that carries no current — a long, smooth contact channel — these are the reasons behind Pressure-Lock's performance. You get these quality features in no other terminal design.



*Progress Is Our Most Important Product*

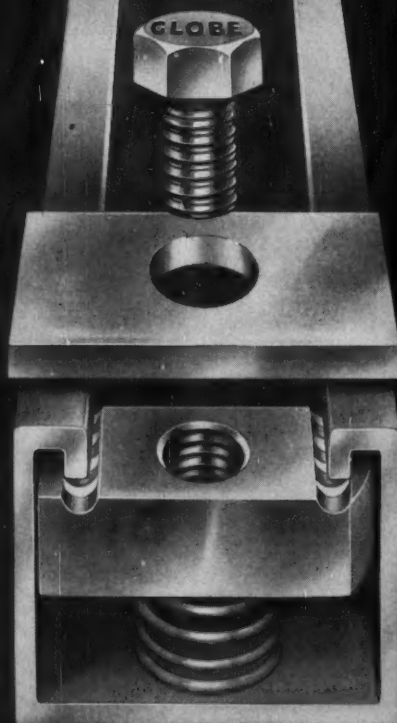
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## MOTOR SHOPS

# New York Motor Shop Serves Printing Industry

Wiring and servicing printing equipment requires a specialized operation. Benjamin Electrical and Engineering Works, Inc. offers complete customer service; from repairing and rewinding special motors to contract maintenance programs.

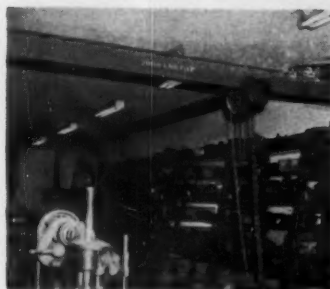
**W**HILE the Benjamin Electrical Engineering Works, Inc. is one of the larger electrical contractors in New York City, they also have a well-equipped motor shop. Since New York City is the heart of the printing business, the motor shop operation is geared to service this specialized trade. Not only does this firm repair and rewind all types of printing motors, but they also have a number of regular maintenance contracts to service this equipment and keep the presses rolling with a minimum of downtime.

Because many of the motors for printing equipment are unusual types and frame sizes, Benjamin is proud of their vast stock of special motors and auxiliary equipment as well as standard items. As shown

in accompanying photos, they can offer quick replacements for any defective unit from large press drive motors to linotype motors. And for trouble shooting, servicemen for Benjamin are familiar with every make of printing equipment available. Over 40 years of experience with this equipment has made this possible.

For rewinding ac and dc motors, the firm can handle sizes up to 125 hp. Moreover, they carry a complete stock of brushes, brush-holders, bearings and other important components common to printing equipment.

Accompanying photos attest to their well-laid-out motor shop. Starting at the rear loading platform, the first overhead crane



**OVERHEAD CRANEWAY** covers the entire length and width of the Benjamin Electrical and Engineering Works, Inc. motor shop. At the far end of the picture another crane, equipped with an electric hoist, relays equipment from the main shop through an open shaftway to the basement area.

picks up a defective motor. From there, it is transferred to a second crane, which spans the entire width and length of the motor shop. Thus the motor can be delivered to any part of the shop. Usually the motor is delivered to a large table, equipped with casters. Here a mechanic determines what repairs are necessary. If the repairs are simple such as bearing replacements, turning down a commutator, or welding



**BASEMENT STOCKROOM** stores special motors and auxiliary devices for printing equipment that may be needed for Benjamin's customers. Overhead crane also spans the entire area. Equipment from here is moved via four separate crane ways to the loading platform.



**SAM RABINOWITZ**, general superintendent for Benjamin Electrical and Engineering Works, Inc., operates the electric hoist which receives heavy stock equipment from basement area. The equipment is then transferred to the motor shop crane way.



**LOADING PLATFORM** crane way transfers heavy motors to motor shop crane way. With four separate crane ways located in proper sequence, heavy equipment can be delivered from a basement stockroom at the far end of the shop to the loading platform quickly.

## NEW...FROM HEINEMANN



### 200 AMP SERVICE ENTRANCE EQUIPMENT

... small box  
... big breaker

Customers looking for more electrical power will find a lot to like in this unit. Capacity is a full 200 amperes. "Full" because the Heinemann hydraulic-magnetic breaker makes de-rating as obsolete as yesterday's weather forecast. You can put this equipment next to heat lines, or let it sizzle in the summer sun. It always carries full rated current, always trips as specified. No thermal elements . . . no temperature-caused nuisance tripping.

Installation? Painless. There's enough space inside for two hands and wire. Solderless screw-type connectors save time and trouble. Knockouts are plentiful, placed so conduit can be run-in from any angle.

Cost? A little less than you are used to paying for equipment that supplies equal capacity after de-rating.

The size is another pleasant surprise . . . slightly smaller than fused pull-outs of the same rating. The equipment is rated at 120/240V AC, two- or three-wire service, and is available in indoor or raintight, tamperproof outdoor enclosures of heavy-gauge steel.

MORE QUESTIONS? SEND FOR BULLETIN 1003

**HEINEMANN**

**ELECTRIC COMPANY**

132 Plum Street, Trenton, N. J.

*Circuit breakers*

S.A. 2044



**SMALL PARTS STOCKROOM**, conveniently located in Benjamin's motor shop, contains sturdy well-marked bins for all motor components.



**MOTOR STORAGE BINS** of rugged construction store heavy motors used with printing equipment. Notice slanted bins for easy removal of heavy motors onto overhead craneway hoist.

loose squirrel-cage stator bars, the work is quickly done by Benjamin's specialists. If a rewind job is found necessary, old windings are burned out by torch and stripped after it has been rolled over to the degreasing bench and cleaned.

Even though motor repairs are promptly made, it is probable that a replacement motor has been installed when the defective motor was removed, particularly with Benjamin's steady maintenance contracts. And here's where their customers who have maintenance contracts benefit. Once Benjamin signs such a contract, skilled maintenance personnel survey the customer's equipment. They note key equipment and parts, and make certain that replacement will be available in the event of an emergency. Of course, their regular maintenance procedures help to prolong the life of equipment and reduce shutdowns. But due to the rugged environment of printing equipment





THIS HIGH-VOLTAGE CURRENT-LIMITING FUSE...

## **Just interrupted 60,000 amps!**

This General Electric EJ-2 current-limiting fuse just interrupted a damaging short circuit—without discharge or noise. You know, because the protruding indicator on the ferrule tells you so. (A cupped disc indicates operation for some types and ratings in General Electric's non-expulsion line.)

Because there is no discharge, G-E non-expulsion fuses do not need vents,

mufflers, or reinforced cubicles. Less space is required.

Available in all standard voltage ratings from 600 to 34,500, and in a wide range of amperage ratings, these fuses are sure to meet your requirements for protection of capacitors, motors, transformers, load centers, and feeder circuits, and for

general purpose duty. They're available for use indoors or out.

Want more information? Contact your G-E sales representative. Or write to Section 497-02, General Electric Company, Schenectady 5, N. Y.

**GENERAL  ELECTRIC**

# Takes the PULL out of wiring conduit!



## JET LINE® WIRE PULLER

With the new Jet Line Wire Puller, one man can do the work of SIX men pulling by hand — safely and without strain. You can say goodbye to backbreaking hand pulling and hard-to-handle power winches on nearly every job! The Jet Line Wire Puller saves you work, saves you time, and pays for itself again and again!

### Jet Line® Wire Puller offers many exclusive features

#### Safe, easy to use

Designed for use with non-conductive Jet Line Poly Rope — safe around "hot" areas, eliminates dangerous hand pulling on ladders, scaffolds. Weighs a mere 12 lbs.—easy to handle even in confined places. Grips on pipe—so you can start pull anywhere along run.

#### Constant pull, unlimited runs

Jet Line Wire Puller maintains a constant 20 to 1 ratio through entire pull. There's no loss of power as with other pullers, because there is no storing of cable on drum. Pulling drum automatically takes up, pays off rope—permitting runs of any distance.

*Ask your distributor for complete details and demonstration, or write*

**JET LINE**  
PRODUCTS, INCORPORATED

615 Fugate Avenue, Charlotte 5, N. C.

5378



**A. NEGGSMITH**, motor shop foreman for Benjamin Electrical and Engineering Works, Inc., N. Y. C., stands behind small-motor rewind bench. To the right, spools of magnet wire in various sizes are neatly stored in marked bins.



**LARGE BAKE OVEN** can handle motors up to 125 hp. Thermostat and time clock to the right provide close regulation of temperature and baking time. A small bake oven for fractional horsepower motors is located below control equipment. Both ovens use electric strip heaters as the means of heat.

(ink, lead, etc.), failures are bound to occur. However, quick replacement service provides the answer to keeping downtime of critical equipment to a minimum.

Two additional craneways provide quick delivery of heavy equipment from the large stock room located in the basement area below the motor shop. A replacement unit is hoisted and moved along the basement stock area to an open shaft-way. Then an electric hoist takes over and transfers the equipment to the main floor craneway. And finally the equipment is transferred



45¢

## on the dollar

### HOW TO SAVE THIS KIND OF MONEY ON SERVICE ENTRANCE CABLE...

Compare the cost of three-conductor SE-U for 150-amp use.

In copper, you'd pay \$947 per 1000 feet for 1/0 AWG cable. But, in Rome's aluminum service entrance cable, you pay only \$520 per 1000 feet for the 2/0 AWG size to do the same job.

That's a 45% saving.

Similarly, you'll find that aluminum cable costs less than copper right up and down the scale of sizes.

#### **Installs easily**

Heft a length of Rome's aluminum cable and you'll also see why it installs faster and easier than copper. It weighs less, handles easier, and has improved color coding on the insulators for fast identification.

#### **Save now**

Start saving money on your next service entrance job. Switch to Rome's aluminum SE-U. Your Rome distributor can supply prices, information and cable.

Rome Cable Division of Alcoa, Dept. 7-11, Rome, N.Y.

*(Figures are based on prices as of August 1, 1960. Subject to change.)*

**ROME CABLE**  
**DIVISION OF ALCOA**

# 12 REASONS...

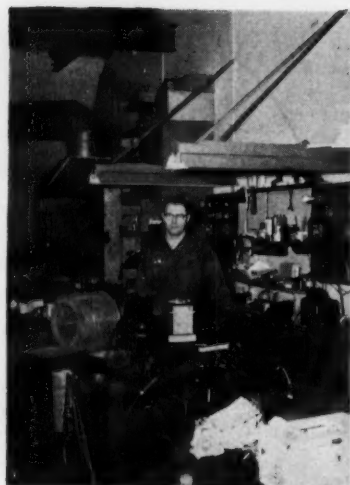
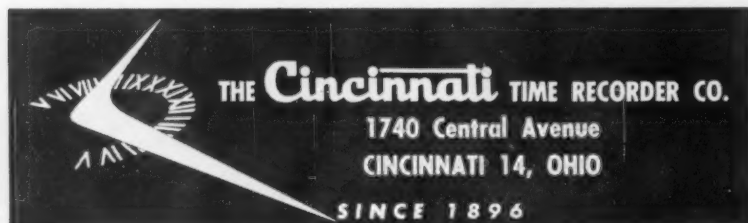
## ... WHY IT PAYS YOU TO SPECIFY CINCINNATI CLOCK AND PROGRAM SYSTEMS



Only Cincinnati Time Recorder offers you all these features. It pays to compare . . . but it pays more to specify Cincinnati Clock and Program Systems because you get:

1. Time Systems covering any group of requirements . . . from basic clock and program control through the most exacting control, signalling and communications requirements.
2. Simplified program setting . . . push a roller on a pin. Both are re-useable and require no tools or special skills.
3. Minute-to-minute programming . . . individually calendared program circuits, with single knob control.
4. Entire system may be controlled or synchronized to exact time from the master unit.
5. Automatic hourly clock supervision . . . up to 58 minutes slow and 57 minutes fast . . . plus twice daily supervision with a 12 hour control range.
6. 12 hour spring reserve power . . . for continuous operation throughout line power failure.
7. Plenty of power . . . controls an unlimited number of secondary clocks.
8. Engineered simplicity . . . for lower installation cost and minimum service.
9. Simplified installation . . . surface or flush mounting with exclusive swing-out trunnion mounting for easy access.
10. All switches enclosed (dust and moisture free) snap-action type rated at 15 amps.
11. Rugged, U.L. Approved Construction . . . for safe, long life.
12. Nationwide service . . . more than 150 service locations.

Call your Cincinnati representative for a discussion of your particular application. Or, write for our Time Systems Handbook . . . an easy reading guide to good equipment.



**TYPICAL WORK BENCHES** are well-equipped and lighted. Note test boards in rear of photo, used to check out ac or dc equipment. Recently overhauled linotype motor can be seen next to the blower unit on the work bench.

to the loading platform craneway to a waiting service truck.

In the motor shop, two electrically heated ovens handle the bake out procedure for rewound motors. The large oven will take stators up to about 125 hp, while the small oven handles fractional hp sizes. An adjustable thermostat and time clock are located near the ovens, and they provide close heat regulation during the bake. By means of a double-throw switch, the heat controls tie into either the large or small oven, as desired.

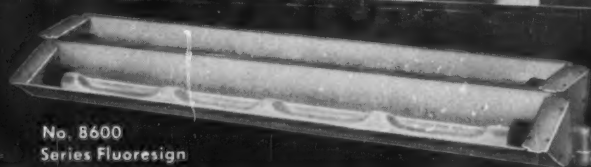
Test benches are provided with an array of voltage sources, ac and dc, to check out equipment. Other interesting motor-shop features are shown in accompanying photos.

Benjamin Salzhauer is the owner of the firm. A. Neggesmith is the foreman of the motor shop.



**STANLEY HORN**, electrical inspector for the NYBFU, headed a Rochester, N. Y., delegation to the recent IAEI Eastern Section meeting, held in Portsmouth, N. H.

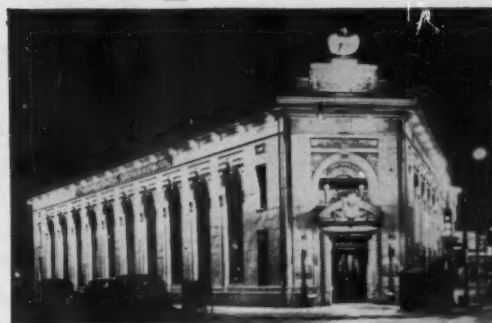




No. 8600  
Series Fluoresign



No. 3151-A Floodlight



## Widest line of fixtures lets you achieve decorative lighting effects the one best way for each job

When you plan an outdoor application for dramatic architectural lighting, plan it the way you know is best for the job, then see your Revere wholesaler for the lighting equipment required. From Revere's complete line, you can select exactly the right fixtures to give the decorative lighting effect you want.

Revere offers the industry's widest line of matched outdoor lighting equipment. For decorative lighting, or parking lots, or sports areas, or airports—or for virtually

any outdoor application — Revere equipment lets you solve the problem the one *best* way. Whatever you need — hinged or rigid poles . . . mercury, incandescent or fluorescent luminaires . . . floodlights, fixtures, fittings — can be supplied by Revere in the size and types specified in your plans.

Ask your wholesaler about Revere outdoor lighting equipment for your next job. For a copy of Revere's catalog, write to us.

**Revere**  
ELECTRIC MFG. CO.

## OUTDOOR LIGHTING

Revere Electric Mfg. Co. • 7420 Lehigh Avenue • Chicago 48, Illinois (In suburban Niles)  
Long Distance Phone: Niles 7-6060 • Chicago Phone: SPing 4-1200 • Telegrams: WUX Niles

In Canada: Curtis Lighting, Ltd., Leaside, Toronto, Ontario

*Under  
this  
dynamic  
new  
signature  
Edwards  
moves  
ahead*



**EDWARDS**

*Dependable electrical signaling products have borne the Edwards name for almost 90 years. Now, under its dynamic new signature, Edwards moves into an era of expansion and growth to meet the demand for ever-broadening product applications.*

■ *Look for the E—for Edwards. It's your guarantee of dependable communication products and systems you can specify and install with confidence. A nationwide network of reliable distributors and Edwards sales representatives stand ready to work with you at any time. Edwards Company, Inc., Norwalk, Conn. (In Canada: Edwards of Canada, Ltd, Owen Sound, Ontario).*

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### ◀ USE THESE CARDS

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Use first line of boxes. Insert item numbers of products on which more information is desired.

#### ● CATALOGS, BULLETINS AND ENGINEERING DATA:

Use second line of boxes. Insert item numbers of literature desired.

#### ● ADVERTISEMENTS:

Use third line of boxes. Insert page numbers of advertisements on which additional information is desired. Where more than one advertisement appears on the page, include the manufacturer's initials.

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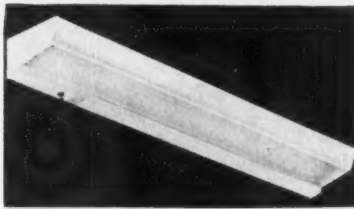
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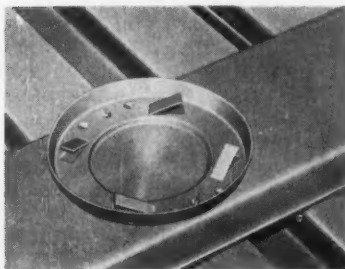
# Product News



**Lighting Fixture (1)**

A new fluorescent hospital bed light featuring both downlight for reading or patient examination, and uplight for general room illumination. Units are available in 2-ft or 4-ft models. Lighting surfaces are shielded with Cleartex prismatic plastic panels. Fixture is equipped with either single-lamp trigger-start ballasts in the 2-ft model or two single-lamp rapid-start ballasts in the 4-ft models. These are controlled by a 2-circuit switch. Unit can be used for downlighting only, uplighting only, or both. Switch is on bottom of wall mounted unit and convenience outlet is located next to switch.

*Day-Brite Lighting, Inc., St. Louis, Mo.*



**Fittings (2)**

New line of Q-Electrical fittings features headers with exclusive knock-out access holes. The knock-out caps make outlet changes easier. Concrete fill over caps is easily removed, clearing the way for installation of junction fittings without drilling. After junction fittings are installed, area is grouted and ready for external outlets.

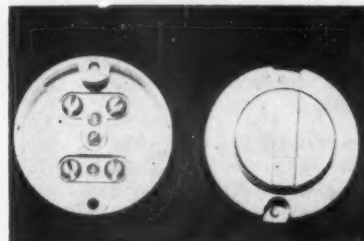
*H. H. Robertson Co., Pittsburgh 22, Pa.*

**Pushbutton (3)**

An oil tight, illuminated pushbutton that combines functions of a pushbutton and an indicating light in a single unit has been introduced. This unit incorporates a color-

coded, molded type transformer that is designed to be immune to voltage surge lamp damage. It can operate with multiple contact blocks with any combination of NO or NC contacts. Other features include base and one-hole mounting, functionally styled plastic lenses in red, blue, amber, green, clear or white. Pushbutton is available for 110-, 220-, 380-, 440- and 550-volt applications. Literature Pub. LO-104 is available.

*Cutler-Hammer, 228 N. 12th St., Milwaukee, Wis.*



**Fire Detector (4)**

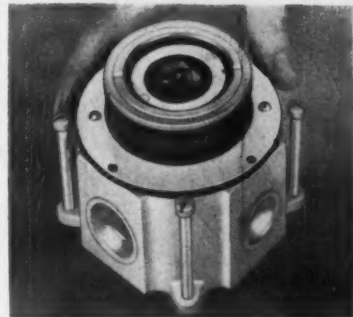
A fixed-point thermostat set to operate at 132° for ordinary locations and also set at 175° for attics, boiler rooms, etc. Contacts are silver, plated with gold and will operate at low voltage. Contacts are sealed. UL lists detector at 6 to 24 volts, 1 amp ac or dc, open circuit. The detector is bi-metallic and can be heat tested at any time as it is self-restoring. Model "F" may be flush mounted in ceiling by using a ceiling plate.

*Fire Alarm Thermostat Corp., 53 West 23d Street, New York 10, N. Y.*

**Plastic Sleeve (5)**

A plastic cable sleeve installed temporarily over an unfinished joint or termination will keep dirt and moisture from work overnight or for several days. The Universal protection kit consists of a plastic sleeve long enough to cover the cable point or termination, waterproof paper to keep plastic clean, tape, desiccant, and humidity indicator. Sleeve is slipped over one of the cables to be spliced and covered with waterproof paper to keep it clean.

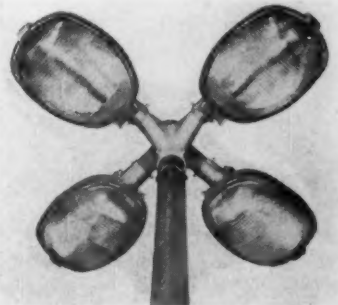
*G&W Electric Specialty Company, 3500 West 127th Street, Blue Island, Ill.*



**Floor Box (6)**

A new "800-CI" cast-iron floor box for application where positive waterproof installation is required. Features include ability to accommodate widest range of receptacles, including 2-wire and 3-wire, NEMA grounded, T-slot and twist-lock types through 20-amp capacity. It also has a large handhole for fishing of conductors and a mounting ring that facilitates field installation of intercommunication, microphone and telephone receptacles. Floor plates accept 1/2-in., 3/4-in. and 1-in. conduit. All components of the series are interchangeable with standard "800" series.

*National Electric Div., H. K. Porter Co., Inc., Pittsburgh, Pa.*

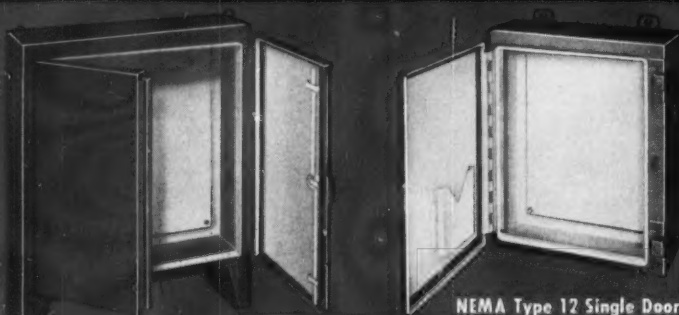


**Luminaire (7)**

The new Quad-Oval is a multiple luminaire for area lighting of parking lots and malls. Its reflector and glassware combination provides high-intensity, glare-free illumination. Its light distribution pattern approximates a square. Available in two models, each using four mercury lamps. No. 5452 uses 400-watt mercury lamps and No. 5453 will accommodate a 100-, 175- or 250-watt mercury lamp. Bulletin 400-16-A is available.

*Revere Electric Mfg. Co., 7420 Lehigh Ave., Chicago 48, Ill.*

# BOSS ELECTRICAL ENCLOSURES



NEMA Type 12 Double Door

NEMA Type 12 Single Door

## BOSS

When you need consistent high quality and dependable, fast delivery, call for BOSS electrical enclosures.

BOSS J.I.C. and NEMA wiring boxes, trough and wireway provide protection against oil, water, dust or dirt. All BOSS boxes and wireway are phosphatized before baked enamel finish is applied.

"Specials" are quoted promptly, fabricated accurately to your specifications and serviced for quick shipment.

Write for catalog which shows the complete line of BOSS products carried in stock for immediate shipment. Sold through leading electrical distributors everywhere.



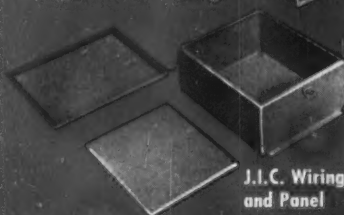
Oil Tight Console



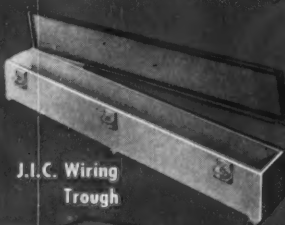
Complete Line of Fittings



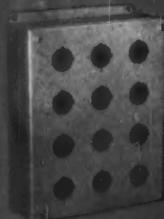
J.I.C. Flanged Hinge Cover



J.I.C. Wiring Box and Panel



J.I.C. Wiring Trough

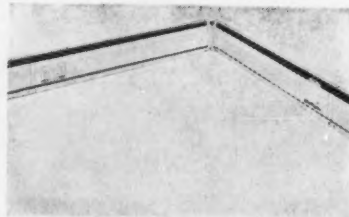


Oil Tight Pushbutton



NEMA Type 1

**THE HUENEFELD CO. ENGINEERED PRODUCTS DIVISION**  
2705 SPRING GROVE AVE. CINCINNATI 25, OHIO



### Electric Baseboard (8)

A new thermal cutout is featured on the F Series electric baseboard. This safety feature is designed to cut baseboard unit off if it is overheated. If any object should fall on baseboard and obstruct air flow, circuit will automatically be broken before heat reaches danger point. Remove obstruction and it goes back to work automatically. Unit also features an improved air flow design with greater wattage per lineal foot yet it maintains low 125° surface temperature. Heating element is fully enclosed. F Series is made in 32- and 48-in. sections.

*Cavalier Corporation, 343 West First St., Chattanooga 2, Tenn.*

### Receptacle Cover (9)

New WR86C weatherproof cover assembly with a 360° swivel snapcap. Complete cover may be swiveled to any point within a full circle and locked in place. It accepts all standard single-gang receptacles including 20- and 30-amp, 3-wire twist-lock types. Made of solid brass, cover plate is supplied with a self-seal gasket and mounting screws.

*Perfect-Line Mfg. Corp., Hicksville, L. I., N. Y.*

### Switch (10)

Designed for ease of installation in metal-conduit wiring systems, the new KL series of heavy-duty limit switches provide for right-hand or left-hand mounting, easy removal of basic switch for connection outside metal case, and O-ring sealed side plate and neoprene boot-sealed operating plunger for protection against dust, oil, condensation, or moisture. Operation of switch is by direct-over travel plunger, roller overtravel plunger, adjustable roller-arm, or adjustable hand actuator. Basic switch used in KL series is Type 2HL-5, listed by UL for single-pole, double-throw operation at 2 hp 250 volts ac, 1 hp 125 volts ac, 20 amps 125 volts ac. Catalog No. 30-1 is available.

*Unimax Switch Div., The W. L. Maxson Corp., Ives Road, Wallingford, Conn.*

### Cable (11)

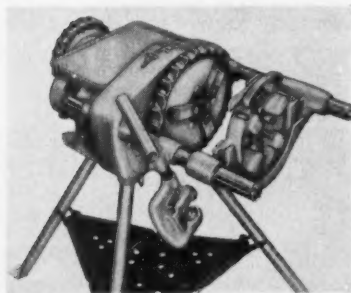
A new plastic jacket non-metallic sheathed cable known as Amerflex. The cable which is constructed of thermoplastic inner conductors and jacket is designed to simplify and speed wiring. It is color coded. Cable having ground wire has green markings and cable without ground has black markings. UL listed.

American Insulated Wire Corp.,  
36 Freeman St., Pawtucket, R. I.

### Generator (12)

A heavy-duty portable electric generator which produces 3000 watts of ac power, is named Zeus. Model GW-300 will provide packaged power on the jobsite or in other remote locations where electric power is needed. Electric power is generated by a permanent magnet rotating field. The permanent magnet, internally fan-cooled and corrosion protected, connects directly to engine shaft with no coupling. It is rated at 3000 watts, 115/230 volts, 60 cycle single phase. It is equipped with a positive action fuel pump to permit connection to an auxiliary fuel tank of larger capacity. GW-300 has two fuses for overload protection and three power outlets—one 230-volt twistlock and two 115-volt 3-prong sockets.

Borg-Warner Corp., Pesco Products Div., 24700 North Miles Road, Bedford, Ohio



### Tool (13)

Portable Model 101 power twister features a specially designed and precisely balanced yoke and gear drive which provides direct connection between twister and threader. Yoke handles Nye No. 2 geared stock for threading pipe and conduit 2½ in. through 4 in. The Nye designed saddle handles quick-opening die heads ½ in., ¾ in. and 1 in. through 2 in. Twister is mountable on a bench, truck or Nye 7-101 tripod stand.

Nye Tool Company, 4120 Fullerton Ave., Chicago 39, Ill.

## SO EASY TO HANDLE

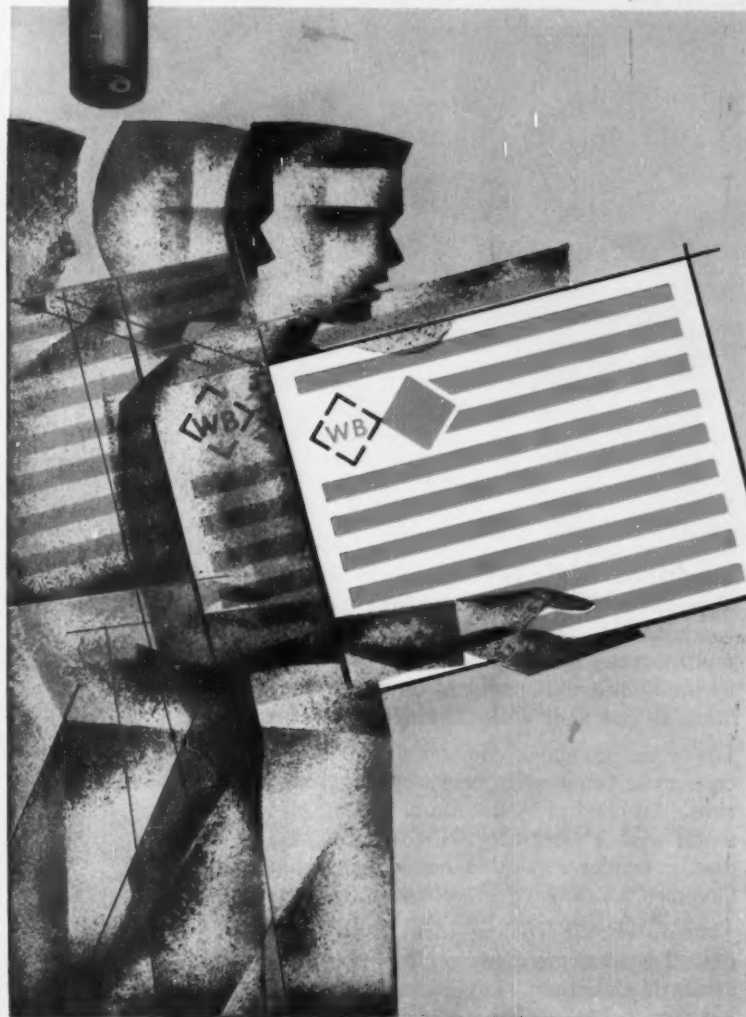
### WB DYNAPRENE PORTABLE CORD

Smaller sizes are packed on spools in cartons . . . Larger sizes in coils, in knockout cartons . . . Easy to identify anywhere . . . Type, size and gage, clearly marked on jacket . . . Safe to recommend . . . Premium quality, long lasting, oil-resistant, neoprene jacket . . . U.L. approved.



Write for free Catalog  
PC-58 "Portable Cord  
and Cable"

NEW HAVEN 14, CONNECTICUT / Telephone CHestnut 8-5515 / TWX: NH 84





# JOB-PROFIT TOOLING IDEAS

FROM GREENLEE



**no special  
attachments  
needed to bend  
ALUMINUM  
CONDUIT  
with Greenlee  
lightweight benders**

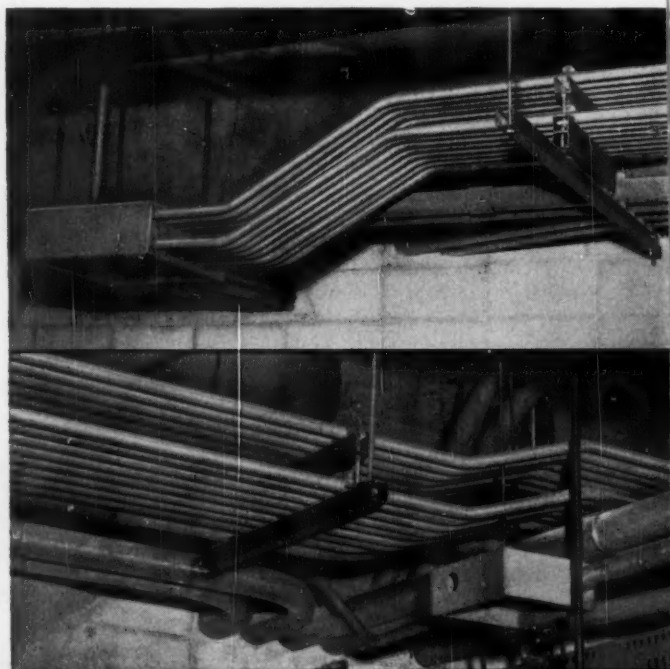
When your jobs call for bending aluminum conduit, you can streamline operations and make big savings in labor and materials with a standard Greenlee lightweight hydraulic bender.

Designed to accommodate *both steel and aluminum* conduit and pipe without special attachments, Greenlee lightweight benders are extra rugged, fast, powerful . . . yet one man can easily transport, set up and quickly make uniform bends.

Shown at right are two views of aluminum conduit installations on a large electrical job now in progress. Top illustration shows 16 parallel runs of aluminum conduit with offsets made by a Greenlee No. 888 multipurpose hydraulic bender. Job is typical of accuracy and uniformity of duplicate bends easily made in one shot with Greenlee No. 888 benders.

Lower picture shows complex duplicate offsets and concentric bends at intersection of several conduit runs. All conduit is aluminum and *all* offsets were made with a Greenlee No. 888 multipurpose hydraulic bender . . . other bends were made with a Greenlee No. 884.

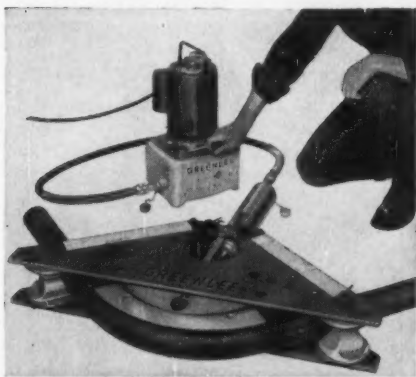
Four Job-Profit Tooling Ideas using Greenlee hydraulic benders are shown on the facing page. High-strength aluminum alloy construction of Greenlee benders holds weight to a minimum for easy portability and one-man operation.







**Idea for faster, more efficient bending** — Cost for *all* your bending jobs can often be reduced by half or more with a Greenlee No. 880 lightweight hydraulic bender (above) for  $\frac{1}{2}$ " - 2" aluminum or steel conduit. Available for hand or power pump operation, the No. 880 makes 90° bends in 2" conduit in approximately five minutes with hand pump . . . less than a minute with a Greenlee power pump. Conduit is inserted and removed from the front . . . permits fast "in-place" bending.



**Idea for controlling costs, making better installations** — Actual on-the-job figures show that with a Greenlee No. 883 bender, costs for making bends in aluminum or steel conduit run about one third of that for using manufactured bends and fittings. Complete portability of this lightweight unit makes transportation fast and easy. The No. 883 accommodates eight sizes of conduit from  $\frac{1}{2}$ " - 3" . . . requires only one size of pipe supports for complete range. Fast hand or power pump operation, plus mobility make this compact bender one of the most important tool investments you can make today.

**Idea for streamlining bending operations on large-diameter conduit**—Contractors across the country are finding big aluminum and steel conduit installation jobs are quickly completed with better results, more uniform quality when they put a Greenlee No. 884 lightweight hydraulic bender to work. Forty tons of ram pressure quickly make 90° bends in one shot in conduit ranging from  $\frac{1}{2}$ " - 4". Operated with standard hand pump or Greenlee power pump.



**Idea for making offsets in seconds, with one setting, one shot**—When job requirements call for offset bends, make them on the job—in seconds—with a Greenlee No. 888 multi-purpose hydraulic bender. Offsets always correctly aligned—no doglegs! Easily operated by one man, this bender also makes 90° bends close to the end of the pipe in one shot. For  $\frac{1}{2}$ " - 2" conduit, the No. 888 features hand or power operation . . . heavy-duty casters for easy transportation.

Greenlee Job-Profit Tooling offers a complete line of timesaving tools for electrical construction. Get the complete story on how they can help you to control costs, write for Bulletin E-240 today.

**GREENLEE TOOL CO. 1885 Columbia Avenue, Rockford, Illinois**



**JOB-PROFIT TOOLING**

**. . . cost control for contractors**

# ...a ROYAL "POWR-KORD"

for every job!

The *right* extension cord is essential for safe, dependable operation of on-the-job equipment and temporary lighting . . . the *right* size to carry the load, the *right* length to supply the power without voltage drop. That's why there's a Royal heavy-duty POWR-KORD to fit *every* job. Available in one quality (the very best) . . . two types (rubber and vinyl) . . . three colors (red, black, yellow) . . . four wire sizes (12, 14, 16, 18) . . . and over five handy cord lengths (10 to 100 ft.). See your wholesaler. He has the facts — and Royal POWR-KORDS in stock, ready for your work.



**ROYAL ELECTRIC CORPORATION**  
**PAWTUCKET, RHODE ISLAND**

In Canada:

Royal Electric Company (Quebec) Ltd., Pointe Claire, Quebec

## Lamp

(14)

A 1500-watt Quartzline incandescent lamp designed to operate on 240-volt power supplies. Quartzline lamps differ physically from other incandescent types in that they come in quartz tubes, less than half an inch in diameter, rather than in glass bulbs. They are used to flood-light industrial, commercial and institutional buildings, inside and outside, and such areas as football fields, race tracks, golf courses, etc.

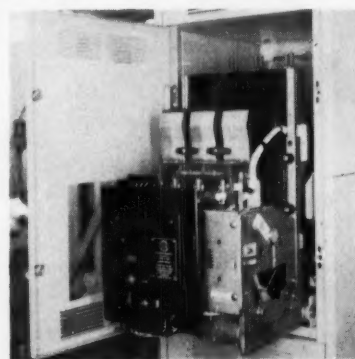
General Electric Co., Nela Park, Cleveland 12, Ohio.

## Tool

(15)

An improved "Drill-Hammer" that converts a rotary drill to a power hammer for masonry anchoring has been introduced. Designed especially for fastening fixtures overhead, unit saves time and effort in shifting from rotary to percussion drilling. Attached to a 1-in. high-speed rotary drill, hammer will drill holes, even in hard masonry, for Rawlplugs and similar anchors for screw sizes from No. 6 through No. 20. It is adjustable for light, medium, or heavy blows, to suit hardness and thickness of masonry.

Rawlplug Company, Inc., 248 Petersville Road, New Rochelle, N. Y.



## Circuit Breaker

(16)

New, low-voltage current-limiting circuit breakers which provide high-speed protection against fault currents up to 200,000 amps. The K-Don breakers integrate, in a single switchgear compartment, fast-acting, high-capacity fault protection of Amp-trap current-limiting fuses with the protective features of its K-Line stored energy breakers, and a device that prevents single phasing. The current-limiting fuses are connected in series to the line side and in parallel

with a Trigger-fuse device which provides protection against single phasing. The new K-Don circuit breakers are available for electrical or manual stored-energy operation in two frame sizes: K-Don 600, continuous current rating 30 to 600 amps; and K-Don 1600, continuous current rating from 150 to 1600 amps, for applications up to 600 volts ac or 250 volts dc. Both provide fault-current interruption up to 200,000 rms amps. Ratings of Amp-trap current-limiting fuses for the K-Don 600 range from 400 to 2000 amps; and for the K-Don 1600 from 400 to 3000 amps.

*I-T-E Circuit Breaker Co., 1900 Hamilton St., Philadelphia, Pa.*

#### Clutch (17)

A 5.5 SMR stationary magnet clutch has been added to this line. Clutch has a stationary magnet, ball bearing mounted, for ease in assembly and alignment. Coils can be wound for voltages up to 115 volts dc maximum, and insulated with Class "A" through Class "H" insulation. Unit is also available in clutch-brake combinations designated as 5.5 SMCB. This comes as in integral unit with both drive and driven shafts, and a floor mounting bracket. Torque ratings on both clutch and brake are 45 ft lb, and both clutch and brake are magnetically set. It can be controlled by double-throw relays. Clutch is available in split and thru-shaft arrangements.

*Stearns Electric Corp., 120 North Broadway, Milwaukee, Wis.*

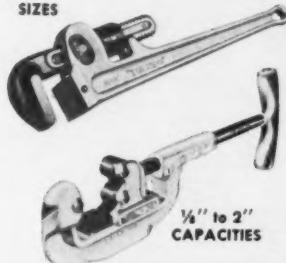
#### Duplex Receptacle (18)

Designed to provide full compliance with code revisions, a new heavy-duty 20-amp U-ground duplex receptacle and a new heavy duty 20-amp ground armored cap have been introduced. Rated at 20 amps, 125 volts, both ground devices extend safety grounding to many additional industrial, commercial and home installations. Cat. No. 877 will also accommodate regular 2-wire caps and grounded 3-wire caps, comprising one outlet for all. No. 809 20-amp ground armored cap, with cord clamps, has parallel, tandem and U-ground prongs arranged to conform with the new code revisions for 20 amps. Its diameter permits two caps to fit the No. 877 receptacle. UL listed.

*Eagle Electric Mfg. Co., Inc., 23-10 Bridge Plaza South, Long Island City 1, N. Y.*

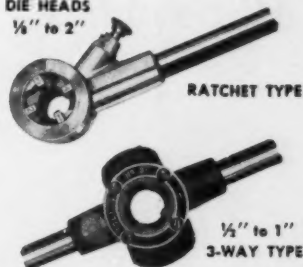
## TOLEDO® *Quality Checked* **CONDUIT and PIPE WRENCHES • CUTTERS • THREADERS**

6" to 48"  
SIZES



1/4" to 2"  
CAPACITIES

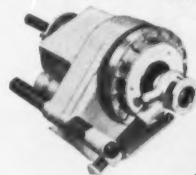
DIE HEADS  
1/4" to 2"



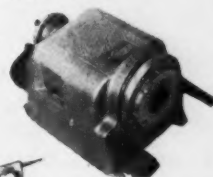
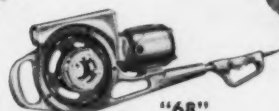
RATCHET TYPE

1/4" to 1"  
3-WAY TYPE

CONVERT HAND TOOLS TO POWER



PORTABLE  
POWER DRIVES



"58"

"68"

"88-A"

#### NEW, Advanced Features

Here are a few of many Toledo Quality Checked Pipe Tools with extra values built-in, yet they sell at popular prices. When you see and buy Toledo Pipe Tools you get advanced design and Toledo engineered mechanical features that give you better job performance and long service life.

Don't settle for anything less than the best—

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**TOLEDO®** *Quality Checked*

**PIPE THREADERS • WRENCHES • MACHINES • TUBING TOOLS**

**THE TOLEDO PIPE THREADING MACHINE CO...TOLEDO 3, OHIO**



# SUPER AC

*Built for  
Long Life...*

## 20AC1 Super AC Switches

Modern, attractive Kroger Building, designed for many years of continuous service to downtown Cincinnati, uses P&S 20AC1-I Super AC switches. Heavy silver alloy contacts mounted at the nodal point provide long life at full-rated capacity on inductive and tungsten filament loads.

High quality 15- and 20-ampere P&S Super AC switches meet all Underwriters' Laboratories requirements, including rugged overload test of 4.8 times rated current, at 40-50% power factor and rated voltage.

As companions to P&S Super AC switches, 9260-I duplex and 5242-I grounding duplex outlets are used in the Kroger Building.

Write for information, Dept. ECM161

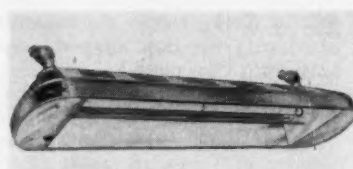
20AC1-I

KROGER BUILDING  
CINCINNATI, OHIO  
\*  
OWNER  
R. E. DUMAS MILNER  
JACKSON, MISS.

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ARCHITECT-  
ENGINEER  
HEDRICK & STANLEY  
FORT WORTH, TEXAS

\*  
ELECTRICAL  
CONTRACTOR  
BERTKE  
ELECTRIC CO.  
CINCINNATI, OHIO

\*  
GENERAL  
CONTRACTOR  
GEORGE J. FULLER  
CO.  
DALLAS, TEXAS



### Electric Heater (19)

Infrared focused electric heater to spot heat any outdoor or indoor area. Quartz Raye emits 95% infrared radiation via its specially developed fused quartz heating element. It uses a 24-karat gold-plated reflector. Unit can be turned on-off by flick of a switch; resembles a fluorescent lighting fixture and installs easily anywhere a fixture can be suspended, from a ceiling, or mounted to a wall or post. It comes in 110-volt units ready to be wired for plug-in and is also available in 208- and 240-volt units, for direct connection.

Quartz Raye, a division of Pinco, Inc., 1144 South Kostner Ave., Chicago 24, Ill.

### Drive (20)

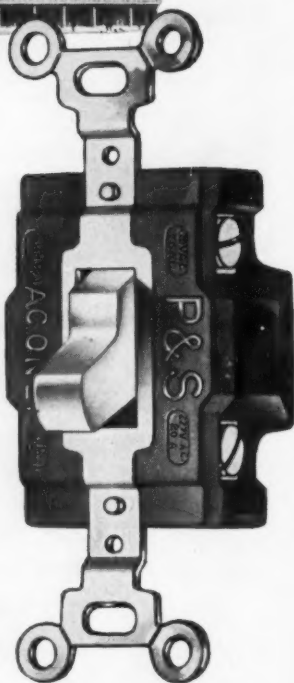
A new variable speed drive has been introduced. Every rpm between 180 and 1800 is obtainable from this unit, when an 1800 rpm motor is incorporated. Using a 1200 rpm motor all speeds between 120 and 1200 are available. Either dripproof or totally enclosed fan-cooled units can be furnished in  $\frac{1}{2}$ ,  $\frac{3}{4}$  or 1 hp.


Lima Electric Motor Co., Inc., Lima, Ohio

### Timers (21)

The addition of several 4-pole switching options in the 7-day and 24-hour time switch lines has been announced. They offer 4-pole switching arrangements for 3-phase lighting applications, also automatic and simultaneous control of four separate circuits and adaptability for all switching combinations. Both can be wired 4-pole single-throw, with four normally open, isolated contacts, for 3-phase lighting applications or 4-circuit control. Wired in this manner, each pole has a 20-amp tungsten load rating. Each pole carries a 40-amp non-inductive load rating. And switch incorporates a single-pole rating of 1 hp. UL-listed, all of the 4-pole switching arrangements operate on 120 or 208/240 volts, 690-volt-amps pilot duty.

Paragon Electric Company, Two Rivers, Wis.



 **PASS & SEYMOUR, INC.**  
SYRACUSE 9, NEW YORK

60 E. 42nd St., New York 17, N.Y. 1440 N. Pulaski Rd., Chicago 51, Ill. In Canada: Renfrew Electric Co., Ltd., Toronto, Ontario



## Time Switch (22)

A new one-dial/three-circuit time switch, developed for traffic signal controllers, has been announced. Called Model No. 8077SK, it is ideal for replacement of older and obsolete type units as well as for new installations. Old equipment need not be altered; unit's mounting plates fit standard mounting switch holes on all makes of traffic controllers. The full day's program is set but once on the one 24-hour dial, with the special tabs on dial. As one circuit is switched "off" the next is instantly energized and proper traffic controller dial placed in service. A "skip" feature enables keeping either or both circuits No. 2 and No. 3 off on week-ends or any selected days of the week. Literature is available.

Tork Time Controls, Inc., Mount Vernon, N. Y.



## Instrument (23)

This new test set provides a means for phase or conductor identification on underground cable systems. Transmitter consists of a packaged steep-wave-front impulse circuit connected to cable terminal which periodically sends a pulse out on one identified conductor and back on another. Transmitter is a dual source device which can be operated from either a 60-cycle supply or from self contained dry cells, type 45, 67½-volt battery. Detector, for use in identifying individual conductors in cable, is a unit similar to a clamp-on ammeter. Transmitter can also be used to identify cable itself at work location by connecting transmitter to cable terminal and grounding its conductors at a termination beyond the work point. Phasing signals can then be detected and cable itself identified by applying coil and ear-phone pick-up to the cable sheath. Bulletin 826 is available.


James G. Biddle Co., 1316 Arch St., Philadelphia 7, Pa.

# NOW!

5kv



3kv



## HIGH VOLTAGE PORTABLE CABLES WITH HIGH NEOPRENE CONTENT JACKET

CERTIFIED 67.32% NEOPRENE

### AND BRONCO XL BUTYL INSULATION

# BRONCO

*Certified* **66**  
NEOPRENE

Bronco Portable High Voltage Cables are built for continuous duty under the toughest, most rugged working conditions to which you can assign a portable electrical cable. They last longer because they are doubly protected. Unsurpassed external protection against oil, ozone, sunlight, abrasion, acids and alkalis is provided by the famous Bronco 66 jacket, a seamless sheath that is certified by a Registered Professional Engineer to contain not less than 67.32% neoprene—highest content in the industry. Internally, each conductor is insulated with Bronco XL Butyl, an advanced material with great inherent dielectric strength, with extraordinary resistance to high temperatures, corona, and aging. The assembled cable is Synchro-Cured, an exclusive Bronco process that provides the cable with a high degree of resilience. Bronco 66 Certified bounces back from extreme mechanical shock, stays on the job under crushing forces that defeat lesser cables. A big plus value is Bronco's patented (U. S. Patent 2867001) branding; complete identification is repeated at exact two-foot intervals on the jacket—vulcanized in so it can't be rubbed off. Bronco 66 Certified High Voltage Types W, G, and SH (shielded types A, B, C, and D) are now available to users through Electrical Wholesale Distributors. Write for a complete description of Portable High Voltage Bronco 66 Certified. Also ask for data on our duct and direct-burial high voltage items.

#### ELECTRICAL CONNECTORS




DESIGNED FOR WIRE BY  
A WIRE MANUFACTURER  
bear the name

**BRONCO**  
GRIP

Selected from the extensive Bronco Grip line of fittings and connectors, shown here in the Type F, high compression, Vise Grip Connector. Features: single bolt with full thread engagement, high re-usability, installed without disassembly, won't fall off line, full compression with any combination of conductor sizes, rounded contours for neat taping. Write for Bronco-Grip Catalog.

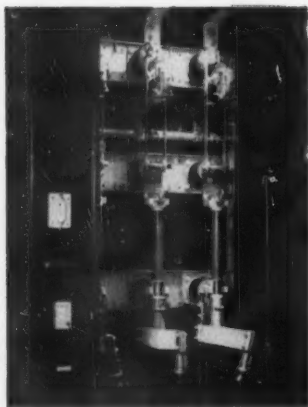
**WESTERN  
INSULATED  
WIRE  
COMPANY**  
Los Angeles 38,



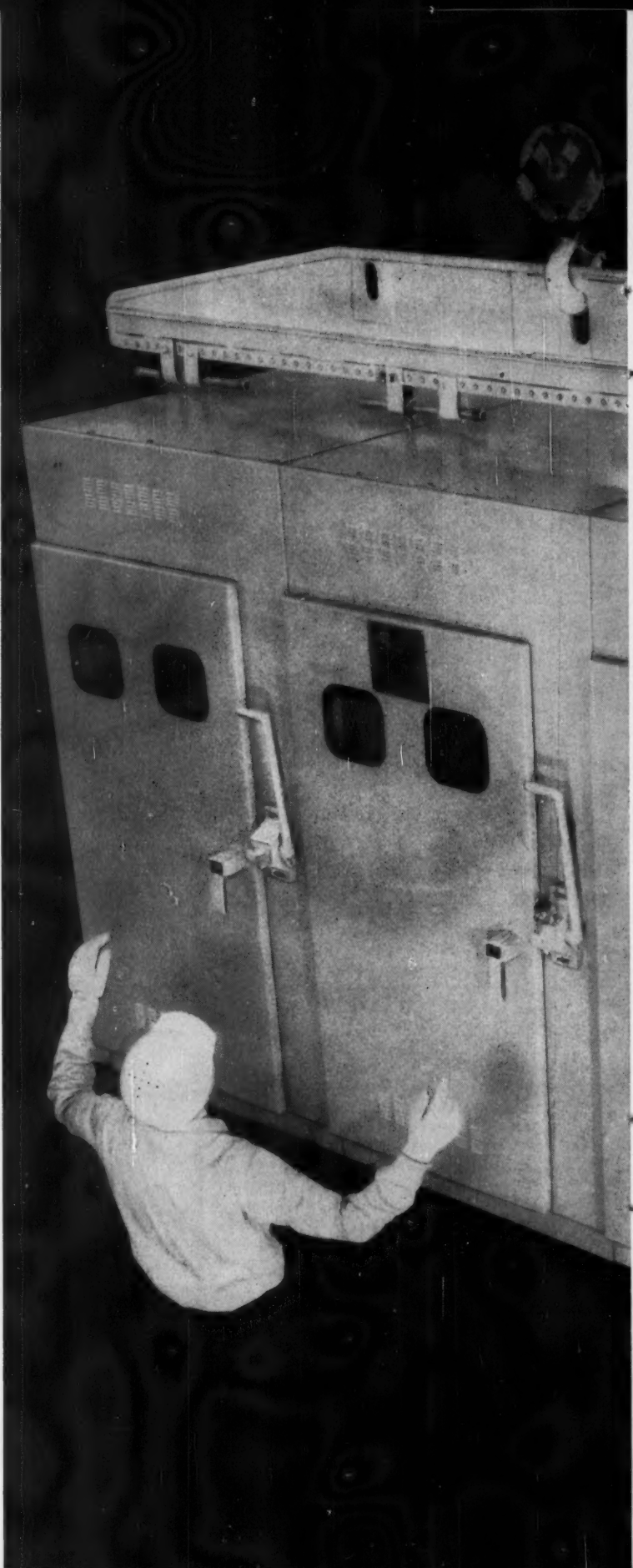
**BRONCO**  
BRED FOR STAMINA

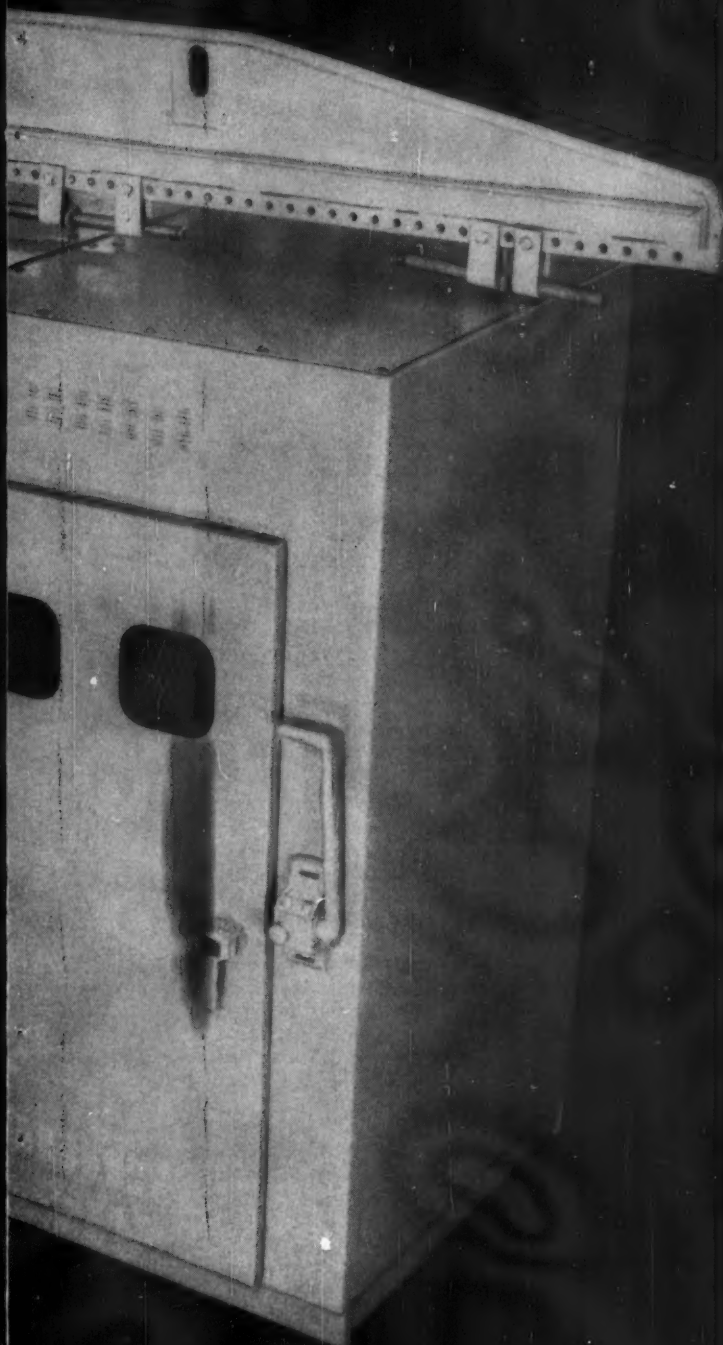
# FAULT PROTECTION

ONLY 125 LB. PER SQ. FT.



Inside view of typical bay, showing load interrupter (for switching), power fuses, and out-going pothead.





## S&C Metalclad Switchgear weighs 60% less — requires 50% less floor space

This S&C Metalclad Switchgear unit, rated 13.8 kv, weighs only 4500 lb., requires only 36 square feet of floor space (excluding aisle space), yet costs only \$5,000. Why? Through the simplicity of S&C's design. Power fuses provide fault protection and load interrupters do the switching. Result: the most dependable yet most economical protection possible for high voltage power circuits in industrial and commercial installations. Besides initial low cost here's how else you save:

**Low installation costs.** Because S&C switchgear is lighter it's easy to uncrate, handle and move into place. Often you can utilize space on roofs or balconies without the expense of reinforcing. The S&C unit shown here weighs only 125 lb. per square foot—60% less than other types of metalclad switchgear.

**Less floor space.** S&C switchgear is shallower. (The unit shown here is only three feet, eight inches deep.) It can be backed against a wall since rear access is not required. No extra floor space is needed at the front for drawout. So you can cut your floor requirements 50%.

Power fuses give protection against permanent destructive faults. Industrial and commercial high-voltage power circuits are not subject to transient faults and so don't need the automatic reclosing feature of the circuit breaker.

S&C fused interrupter gear meets the new National Electrical Code requirements for fault closing. It is available in short circuit interrupting ratings up to 500 mva at 14.4 kv, 250 mva at 4.16 kv. Continuous current ratings are 200, 400, and 720 amperes. Maximum capacity of main bus, 2000 amperes.

## S & C ELECTRIC COMPANY

4433 Ravenswood Avenue • Chicago 40, Illinois

Specialists in High Voltage Circuit Interruption since 1911





**2  
New**

# RIGID Tubing Cutters

Give you Grooved Rollers  
for close flare cut-offs...  
no waste! Also, Enclosed  
Feed Mechanism • Spare  
Cutter Wheel in Handle •



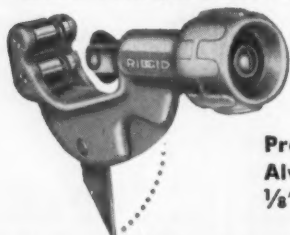
## RIDGID No. 205 Tubing Cutter

Time-Saving, Slide-to-Size  $\frac{1}{8}$ " to  $2\frac{3}{4}$ " O.D. Capacity

Made of lightweight, high-strength cast aluminum alloy, you'll find these new RIDGID Tubing Cutters extra handy. Slight push on handle of large-size-range RIDGID No. 205 snugs cutter wheel against tubing... locks it in position until released. Feed screw fully protected and enclosed... always feeds into tube with easy handle turn... can't jam with chips or dirt. Wheel gives

quick, clean cuts of copper, brass, aluminum tubing and thin-wall conduit... no burr. Grooved rollers give easy flare cut-offs without tubing waste. Tubing always turns freely on 2 of 4 Rollers. Rollers smooth tubing ready for soldering. Fold-in reamer always handy. Spare cutter wheel in handle. Wheel for plastic and aluminum pipe available for No. 205 only.

Conform to Fed. Spec. GGG-C-771b Type II—Class I—enclosed feed mechanism



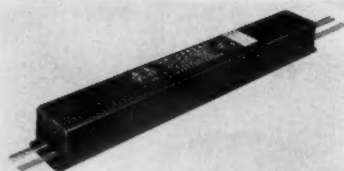
## RIDGID No. 105 Tubing Cutter

Protected Feed Screw  
Always Easy-Turning  
 $\frac{1}{8}$ " to  $1\frac{1}{8}$ " O.D. Capacity

To save time on thin-wall conduit jobs, order these new RIDGID Tubing Cutters today! Your Supply House has them!

# RIDGID

The Ridge Tool Company, Elyria, Ohio, U.S.A.



## Ballast (24)

A low heat rise ballast has been designed for use with 1500-ma rapid start lamps. Catalog No. 930-LH is available for use in installations and fixtures with restricted heat dissipation. Ballast can be used with 72- and 96-in. VHO, PG, SHO, T10 and T10J, 1500-ma rapid-start lamps to provide starting at a low ambient temperature of minus 20°F.

Universal Mfg. Corp., 29-51 East Sixth St., Paterson 4, N. J.

## Fluorescent Lamps (25)

Four new lamps have been added to this line of high efficiency fluorescent lamps. They are two new slimline lamps, 48-in. and 72-in., for use in commercial and industrial applications either in complete installations or in combination with the 96-in. slimline. The complete line of T12 lamps now permits the use of new lamps in all slimline installations including 4-, 6- and 8-ft fixtures. Another addition is the 5-ft, 90-watt T17 size; also a new 40-watt T17 instant-start lamp to be used in school lighting.

Westinghouse Lamp Div., Westinghouse Electric Corp., Bloomfield, N. J.

## Transformers (26)

A new, standardized line of Class B ventilated dry-type transformers in single and 3-phase construction. Primarily for indoor installation, the new line is for use in plants, schools, hospitals, and public buildings. Terminal arrangements and liberal wiring area permit primary and secondary cable entrance from either end of enclosure. Terminals are designed for connecting copper or aluminum cables. Single-phase units are offered in voltage groups of 600 HV and below, 601 HV through 5000, and 5001 HV through 15,000, with kva ratings from 3 through 500. Three-phase units are offered in same voltage groups but with kva ratings ranging from 3 through 2000. Bulletin 160 is available.

Niagara Transformer Corp., P. O. Box 23, Buffalo 25, N. Y.





Wide-Lites at work on the Wanapum Dam Project



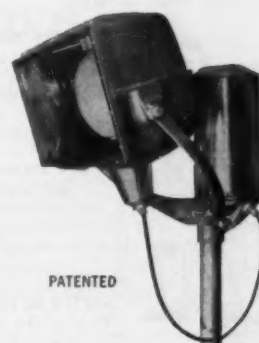
Notice how the broad beam pattern of the two Wide-Lites atop this concrete plant on the Wanapum Dam site flooded the working area with shadow-free light. Good lighting like this speeds up work — cuts down accidents!

## 85 WIDE-LITES speed night operations on Columbia River dam!

On as big a job as the Wanapum Dam Project on the Columbia River, you can't stop work when the sun goes down. But how do you give daylight working conditions on a 24-hour basis to the welders, bulldozers, crane operators and other workers building a sprawling power plant and spillway? Grant County Constructors, sponsored by Morrison-Knudsen Company, Inc., contractors on the Wanapum Dam, does it with 85 Wide-Lites.

Each Wide-Lite with color-corrected mercury vapor lamp will do the work of two or more incandescent floodlights, reducing the number of poles, cross-arms and fixtures required. And Wide-Lites are built for rugged construction use — with cast aluminum alloy bodies finished in epoxy paint for corrosion control. A tempered glass lens protects Wide-Lite's exclusive segmented polished aluminum reflector, and Wide-Lite's patented lamp mounting grips the lamp at both ends to virtually eliminate lamp breakage from shock.

Find out how Wide-Lites can solve your floodlighting problems — and save you money, too! Mail the coupon today.



**WIDE-LITE**

### WIDE-LITE CORPORATION

P. O. Box 191 • Houston 1, Texas

In Canada: Wide-Lite Division, Wakefield Lighting, Limited, London, Canada

OUTDOOR AREA LIGHTS • VAPOR TITE MODELS • INDOOR LUMINAIRES  
MOBILE WORKING LIGHTS • SPORTS LIGHTS • PROTECTIVE LIGHTS

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• **WIDE-LITE CORPORATION** Dept. C111  
• P. O. Box 191 • Houston 1, Texas  
• Please send me more information on Wide-Lites. No  
• obligation, of course.  
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• Address \_\_\_\_\_  
• City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



## ... and for NEARBY SERVICE on Black & Decker

**tools.** Black & Decker maintains 50 factory service branches plus authorized service stations to give your B&D tools the attention mechanical products need periodically. Keep your B&D tools in top condition, on the job all the time.

Only factory parts and factory-approved methods are used. Fast service and reasonable cost, always.



**SWIFTY SERVICE** says  
be sure to ask about:

**FREE TOOL INSPECTION**  
no cost,  
no obligation.

**STANDARD B&D  
GUARANTEE** after  
completion of all  
recommended  
repair work.

You'll find the location of the nearest B&D repair facility in the Yellow Pages under "Tools-Electric," or write for address to: **THE BLACK & DECKER MFG. CO., Dept. 1201-S, Towson 4, Md.**



# Black & Decker

Quality Tool Service



### Outlet Unit (27)

A weatherproof outdoor outlet unit for installation in mobile home parks next to each trailer home, has been developed for use in connection with underground electric distribution systems. All internal wiring is included in each unit and grounded to meet code requirements. Circuit breakers and receptacles are in one compartment and utility lines in another. Each compartment may be locked. Park owner may specify receptacles to be used and wiring is done to utility company specifications. Literature is available.

*Park Metal Products Co., 19197 Sherwood Ave., Detroit 34, Mich.*

### Luminaire (28)

Skylark luminaire utilizes a white polystyrene side diffuser and a crystal clear low brightness bottom panel. Panels are formed so they interlock. The apparent depth of fixture is 2½ in. Polystyrene enclosure is hinged from either side of fixture for easy lamp replacement and fixture cleaning, or can be completely removed. Fixture can be suspension or surface mounted individually or in continuous rows. It is available in 2- and 4-lamp models and 4- or 8-ft lengths.

*Mitchell Lighting Div., Compco Corp., 1800 N. Spaulding Ave., Chicago 47, Ill.*

### Safety Alarm Lock (29)

Emergency exit doors can now be legally locked by means of a patented, new type lock. It permits the dead-bolt locking of exits and fire doors, which are normally required to be left unlocked, in compliance with fire and safety regulations. The Safety Alarm Lock utilizes a heavy dead-bolt with 1 in. throw and keeps door securely and legally locked day and night. When the panic type bar with clapper plate is depressed lock springs back automatically, permitting in-

stant egress. At the same time a piercing alarm, audible 1000 ft, is set off indicating an unauthorized exit. Key carrying personnel can stop alarm and reset lock or bypass alarm for authorized use. For central control in large plants, or for remote exits, lock may be wired to a central indicator control panel.

*Door Controls, Inc., 2066 Hillside Ave., New Hyde Park, L. I., N. Y.*

### Substation (30)

Nucleus of the new substation arrangement is the Regu/Tran unit consisting of transformer, regulators, and by-pass switches, surrounded by a steel or aluminum column structure. This substation, available with up to four secondary feeders, normal optional accessories, and fence, is small in total area, and easy to install. Station consists of a two-column, high-voltage structure with low-voltage section anchored directly to high-voltage unit, thereby eliminating two low-voltage columns. Station can handle one incoming 3-phase line and up to four outgoing 3-phase feeders.

*Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.*



### Lighting Unit (31)

Maintenance procedure for cleaning and lamp changing is simplified with the instant electrical disconnect feature of these Lectri-Lok high-bay lighting units. Reflector, lamp and separable socket are removable as a unit for servicing on bench or floor. Reflectors are designed to meet "RLM" specifications for illuminating large industrial interiors at high candle-power levels without objectionable glare. Sizes are available for 400-, 700- and 1000-watt color-corrected mercury vapor lamps and 300-1500-watt incandescent lamps. UL listed.

*Steber Division, Pyle-National Company, 1334 N. Kostner Ave., Chicago 51, Ill.*



# This is the only Impact Wrench

that has the GUTS to prove  
its maintenance costs peanuts!

Take an Impact Wrench that's built with extra ruggedness clear through. Take a Factory Service Branch network that keeps accurate repair records. Result: *proof positive* that Black & Decker Impact Wrenches have a phenomenally low maintenance cost.

No other Impact Wrench approaches the Black & Decker because no other Impact Wrench can match the power, speed and maintenance-free construction of a Black & Decker. From drive spindle to reversing ring, every part has been designed to eliminate breakdown problems.



## **Black & Decker®**

CUTS MAN-HOURS TO MINUTES

Wherever a bolt, nut, wood or lag screw must be spun, or drilling and tapping done—in machinery moving, installation work, general maintenance or production—a B&D Impact Wrench will do the job faster, with less fatigue, and at lower cost. Mail the coupon or call your B&D distributor for a demonstration. For Sales or Service, look in the Yellow Pages under



THE BLACK & DECKER MFG. CO., Dept. 1201  
Towson 4, Md. (In Canada: Brockville, Ont.)

☐ Please arrange a demonstration of a B&D Impact Wrench.

☐ Please send additional information on .....

Name ..... Title .....

Company .....

Address .....

City ..... Zone ..... State .....



☐ Drills



☐ Hammers

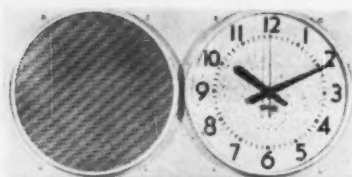


☐ Screwguns®



☐ Bench Grinders





### Clock and Speaker (32)

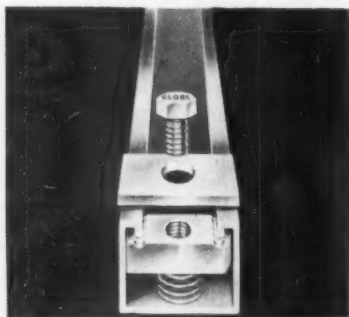
A new line of electric clock and speaker combinations for installation in schools, hospitals, factories and other institutional and industrial buildings. Units combine a clock and speaker companion-mounted in a common panel, and are furnished with either round or square dial components. Clock-speaker combinations are engineered with all types of centrally controlled time, program signal, music, or communication systems.

*Standard Electric Time Co., 89 Logan St., Springfield, Mass.*

### Tape (33)

A new pressure-sensitive, plastic tape for electrical wire splicing remains flexible at temperatures as low as minus 50°F. Designated Permacel 295, the black tape was specifically engineered for use in outdoor applications in cold weather or low temperature indoor splicing. It has an over-all thickness of 8.5 mils. Although designed for cold weather usage, it will perform equally well in moderate temperatures and remains serviceable under operating temperatures up to plus 180°F. Standard bulk rolls are available in 36-yd lengths in widths from 1/4 in.

*Permacel, New Brunswick, N. J.*

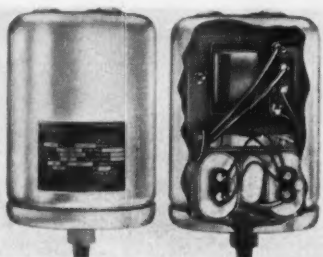


### Channel Framing (34)

A new line of channel framing and fittings for any type of framing or suspension purpose. Completely reusable, it features a line of fittings with triple-grip lock nuts. Fittings include fluorescent fixture hangers, porcelain cable clamps,

concrete inserts, pipe clamps, shelf brackets, beam clamps, and flat plate fittings. Custom-engineered fittings and accessories are available to suit every need. Only two tools are needed for installation, a hack saw for cutting and a wrench for tightening the fittings.

*Products Division, The Globe Company, 4000 South Princeton Ave., Chicago 9, Ill.*



### Transformers (35)

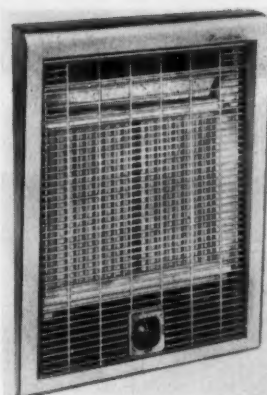
A complete line of mercury lamp transformers in aluminum cases, which are hermetically sealed against weather by mechanical pressure and a special sealant. Bonded tightly to aluminum case, it withstands vibration and mechanical shock as well as temperature cycling. Features which remain unchanged in the aluminum case line include constant wattage circuit which provides low starting current surge, regulation of lamp wattage and output despite line voltage fluctuations, elimination of primary taps, reduced lamp outages due to line voltage drops, and extended lamp life.

*Sola Electric Co., Busse Road at Lunt, Elk Grove, Ill.*

### Tool (36)

Adaptation of the 15DL dustless air drill as a combination drill and hammer for placing concrete anchors in all types of building construction has been announced. The air drill utilizes a dust-inhaling system which draws drilling dust through unit and into dust extractors while anchor hole is being drilled. Then drill converts to hammer action by turn of a "stop rotation" lever, an expansion plug is fitted to bit end of anchor. The 15DLK drill kit, with adaptors for concrete anchor sizes from 1/4 to 3/4 in. and with dust extractor unit, which attaches to drill, is available.

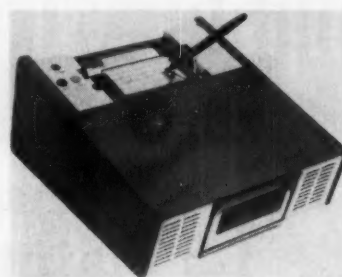
*Thor Power Tool Company, 175 N. State St., Aurora, Ill.*



### Heaters (37)

Totally enclosed elements are featured on new wall-insert heaters. They have nickel-chromium wire embedded in Cordierite ceramic. Enamelled grille lifts out and solid aluminum reflector is hinged at bottom to tip forward for cleaning. Thermostat on heater is liquid filled. Sensitive bulb is placed at bottom under a double baffle to give temperature control. Heater is now available in six wattages ranging from 1.5 to 5 kw. Literature is available.

*Cavalier Corporation, 343 West First St., Chattanooga 2, Tenn.*



### Telescribers (38)

A new line of instruments, known as Model D telescribers, is expected to increase the scope and usefulness of handwritten wire communications. The new communication devices, capable of transmission over a radius of 50 miles, compared with in-plant short distances previously, permit the operator to write directly on paper to send the message, while simultaneously creating up to three carbon copies of the original. And it is expected that telephone instruments will soon be available to intercouple with the telescriber for handling graphic communications anywhere in the world.

*Telautograph Corp., 8700 Bel-lanca Ave., Los Angeles 45, Calif.*



**NEW TRIANGLE BITUMINOUS FIBER CONDUIT  
COMBINES ALL THE BEST FEATURES!**



**A BIG LEAP  
FORWARD IN  
FIBER CONDUIT  
DEVELOPMENT!**

**NOW — A SPECIAL PLASTIC COATING  
TO PROTECT YOUR HANDS**

Here's a fiber conduit that's really kind to your hands. TRIANGLE'S exclusive new transparent plastic coating keeps this conduit clean, easier to handle . . . minimizes skin burn.

**NOW — STRAIGHT LINE  
COLOR CODE STRIPE**

A straight color coding stripe runs the length of each section . . . white for Type I, orange for Type II. And, the TRIANGLE seal and type are printed all along the way . . . for easier product identification.

**NOW — LONG TEN FOOT LENGTHS  
SAVE TIME AND MONEY**

TRIANGLE Bituminous Fiber Conduit comes in long 10 foot lengths (as well as 8 and 5 foot lengths). Longer lengths mean fewer joints, faster installation, lower costs.

**AND MORE TOO — SEE OTHER SIDE**

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New Brunswick, New Jersey



TRIANGLE — FIBER — CONDUIT — TYPE 1

#### **DURABLE — CORROSION-RESISTANT**

The coal-tar pitch material used in TRIANGLE Bituminous Fiber Conduit is completely inert to corrosive soil elements. A lifetime of troublefree service is assured by corrosion-resistance and moisture-proof joints. TRIANGLE Bituminous Fiber Conduit is always in to stay!

#### **SMOOTH BORE**

The smooth, flaw-free inner surface of TRIANGLE Bituminous Fiber Conduit reduces friction and permits fast, easy fishing of cables.

#### **CLEANER-TO-HANDLE . . . EASIER-TO-INSTALL**

The exclusive Transparent Plastic Coating keeps this conduit clean . . . makes the handling of fiber conduit carefree for the first time. TRIANGLE Bituminous Fiber Conduit is light in weight, permitting easier handling of longer lengths. It is easily sawed to fit. Fewer and faster joints, quick installation, save time, labor and money.

#### **EVERY LENGTH TESTED AND CONTROLLED FOR UNIFORMITY**

To make sure TRIANGLE Bituminous Fiber Conduit will be easily and accurately laid, the wall thickness, length, bore and machining of joints are rigidly controlled and tested on every length to conform to Federal Specification WC-581.



*"It MUST Be Right!"*®

### **GET THE FULL STORY ON The Big Leap Forward in FIBER CONDUIT**

**FREE!** Illustrated catalog tells the full story on TRIANGLE BITUMINOUS FIBER CONDUIT, including features, applications, installation procedures, accessories, etc. Fill out this card today to get your copy.  
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**TRIANGLE CONDUIT & CABLE CO., INC.**



EXECUTIVE OFFICES: NEW BRUNSWICK, N. J.

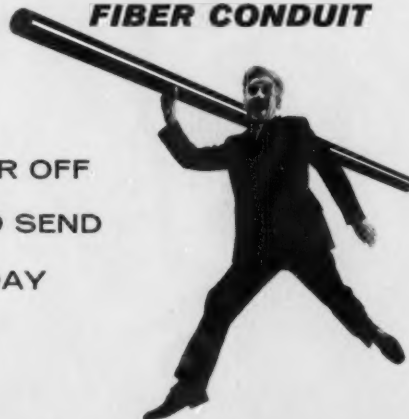
PLANTS: NEW BRUNSWICK, N. J.

LANDISVILLE, N. J.

BOUNDSVILLE, WEST VA.



**TEAR OFF  
AND SEND  
TODAY**



**Tester****(39)**

A small insulation resistance tester with crank handle is an installation and maintenance tool for use in a wide range of field applications. Tests with this unit indicate insulation deterioration on practically every class of electrical apparatus, and wiring system.

*Multi-Amp Electronic Corp., 465 Lehigh Ave., Union, N. J.*

**Wrench****(40)**

Installation of cross arms on poles is considerably speeded with use of new lineman's all purpose kit No. 336C. Basically, the tool is a No. 336 electric impact wrench with a  $\frac{1}{2}$ -in. quick change chuck. Nine bits from  $\frac{1}{2}$ - by 10-in. long to  $1\frac{1}{2}$  in. by 18-in. long and nine double square, long sockets from  $\frac{1}{2}$  in. to  $1\frac{1}{2}$  in. are furnished with wrench in a steel case.

*Albertson & Company, Inc., Sioux City, Iowa*

**Motors****(41)**

A completely new line of submersible ac motors especially designed for close-coupling to centrifugal pumps operating in any depth of water, oil or liquid chemicals, is now available in sizes from  $\frac{1}{2}$  through 40 hp for operation from polyphase power sources, and from  $\frac{1}{2}$  through 5 hp for single-phase connection. Motors are rated at 55°C temperature rise for 30-minute duty in 40°C air, and for continuous duty in 40°C liquids. A reconnectable dual-voltage feature is available on single-phase units from  $\frac{1}{2}$  through 2 hp, and on all polyphase motors. Single-phase control panels are available to meet specific requirements.

*Reliance Electric and Engineering Co., 24701 Euclid Ave., Cleveland 17, Ohio*

**Motor-Generator Set****(42)**

A motor-generator set with two prime movers for use in supplying uninterrupted power for microwave repeater stations has been developed. Utilizing two-bearing construction, the m-g set consists of a Synduction motor, a dc motor, a single-phase generator and exciter within a common yoke. All rotating parts are mounted on a single shaft supported by a bearing at each end and the regulator is located in a cabinet on the side of the set. Brushless type generator operates in conjunction with a static type regulator to supply a 230-volt output plus or minus 1%. Fields and brushes are energized from a 120-145-volt battery with brushes removed from commutator by mechanically linking them to solenoids connected to same source supplying Synduction motor.

*Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.*

**Circuit Breaker****(43)**

New RC-38 circuit breaker is a 2-pole common-trip twin breaker. Available in 15-, 20-, 30- and 40-amp ratings, the device is approved for use in appliance circuits. It requires  $\frac{3}{4}$  in. of panel space. The R-38 twin breaker is now available in 30- and 40-amp ratings also. These devices can be converted to double-pole breakers, with tie-bars, for appliance circuit applications. It is interchangeable with any Zinsco Type T, Q or R-38 and can be used in any existing Magnetrip panel. Bulletin 128 is available.

*Zinsco Electrical Products, 720 Turner St., Los Angeles 12, Calif.*

**Pushbutton Station****(44)**

A new heavy-duty pushbutton station of corrosion-proof, all-rubber, weather-sealed construction. Known as Flexitite Switch, it is recommended for any 2-station pushbutton application, such as start-stop, up-down, forward-reverse, off-on, etc. It meets NEMA types 1, 4 and 5 enclosure requirements for both heavy and standard duty operation. Switch fits all standard FS and FD boxes. Flush mounting can be achieved on metal surfaces. It incorporates micro type 1- or 2-pole switches with normally open and/or normally closed contacts. Bulletin B82 is available.

*Joy Manufacturing Co., Electrical Products Div., 1201 Mackind Ave., St. Louis 10, Mo.*

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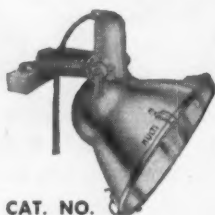
\*Rouzer Sales Co.  
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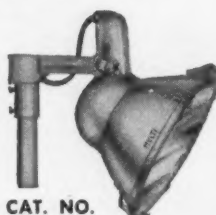
\*Stanley Sales Corp.  
1122 Folsom St.  
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**MULTI  
NEPO****INCANDESCENT—MERCURY VAPOR****FLOOD and AREA LIGHTING  
POLES - BRACKETS - FITTINGS**

The Multi line of quality lighting equipment has been expanded with the acquisition of Nepo Mfg. Co. The combined Multi-Nepo line includes rigid, hinged and pedestal poles, incandescent and mercury vapor luminaires and floodlights, brackets, mountings, fittings and accessories. For school, industrial, airport or hospital lighting, choose Multi, quality lighting equipment for nearly 40 years.

**MULTI FLOODLIGHTS**

CAT. NO.  
7200A



CAT. NO.  
7200C

New Aluminum Enclosed Angle Type Floodlight—Alzak Finish, Wide or Narrow Beam—for Incandescent 750-1500 Watt Lamps or Mercury Vapor 400 Watt Lamp.

**MULTI-NEPO MERCURY LUMINAIRES**

CAT. NO.  
500G

Same general construction as 510CC for ballast mounting outside unit. Ideal for expressway, streets, intersections, parking lots, playgrounds, etc.



CAT. NO.  
600

For use with Mercury Vapor or Incandescent Lamps. For side or pendant mounting. Cast aluminum head, Alzak reflector and stainless steel fastenings.



CAT. NO. 510CC

One-piece cast aluminum housing provides for ballast-in-head. Alzak reflector, prismatic glass refractor for use with 250W and 400W lamps.



CAT. NO. A300

A mushroom luminaire with open Alzak reflector sealed over glass, cast aluminum base. For service station plazas, patios, parks, promenades, campuses and other open areas. Utilizes 250W and 400 W Mercury Lamps.



CAT. NO. 400P

Mercury Vapor perimetric floodlight. An all-purpose outdoor unit for building exteriors, industrial and recreation areas, parking lots, etc.

Write for literature on the complete line of Multi Floodlights and Nepo Luminaires, poles, fittings, mountings, etc. See our Catalog in Sweets.

Send for your copy of catalog literature.

**MULTI****ELECTRIC MFG. INC.**

4231 W. LAKE ST.

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**Catalogs & Bulletins**

(45) **LOADCENTERS.** Bulletin N1-100 illustrates and describes EQ-T dual breaker with non-interchangeability provisions. I-T-E Circuit Breaker Co.

(46) **EQUIPMENT FAILURE.** New instrument application manual D-62, entitled "Methods and Instruments for Maintenance of Generators, Motors, and Power Equipment" tells how to predict motor and electrical equipment failure. Associated Research, Inc.

(47) **MOTORS.** Bulletin GEC-1228D, 2 pages, describes special-service capacitor-start motors. General Electric Co.

(48) **RECLOSERS.** Two new oil circuit reclosers, which utilize electronic control, are described in Bulletin CR1WE. Line Material Industries, McGraw-Edison Co.

(49) **LIGHTING** lease plan Booklet SA-8865 describes the company's new lease plan for lighting equipment. Westinghouse Electric Corp., Lighting Div.

(50) **PHOTO-ELECTRIC CONTROL.** 8-page bulletin contains information about Infrabeam, an infrared photo-electric control. Cramer Controls Corp., Electronics Div.

(51) **CEILING LIGHTING.** 8-page brochure lists a variety of light diffusing panels and specifications applicable to any ceiling lighting system. Luminous Ceilings Inc.

(52) **MOTORS.** Bulletin describes design features, performance characteristics, and size range of redesigned line of squirrel cage induction motors. The Lincoln Electric Co.

(53) **SOUND LEVELS.** Booklet F-10180 describes new sound slide film entitled "Making Sound Behave" which discusses air distribution sound levels. Barber-Colman Co.

(54) **ACCESSORIES** for Types RE and WE reclosers are described in Bulletin CR1CE. Line Material Industries, McGraw-Edison Co.

(55) **POLE TOP SWITCHES.** 12-page bulletin, Section 1, describes expanded line of pole top switches. Powerdyne Inc.

(56) **MEASUREMENT SYSTEMS.** Bulletin 1000, 4 pages, describes op-



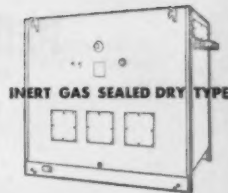
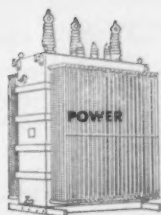
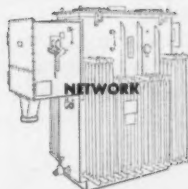
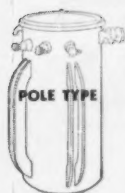


*"That Niagara was out there when I started. It's been delivering power since it arrived. Never caused us a moment's trouble."*

Users confirm it: Niagara Transformers are built to last a long, long time. At every stage in their manufacture, quality is strictly controlled. Everything — raw materials to completed transformers — is thoroughly tested at the Niagara plant. Specialized skills and experience assure bonus construction with liberal overload capacity.

Niagara Transformers are designed and produced for practically every service thru 10,000 kva, 69,000 volts. Write for Bulletin 139. Niagara Transformer Corp., P.O. Box 23, Buffalo 25, N. Y. Representatives in principal cities.

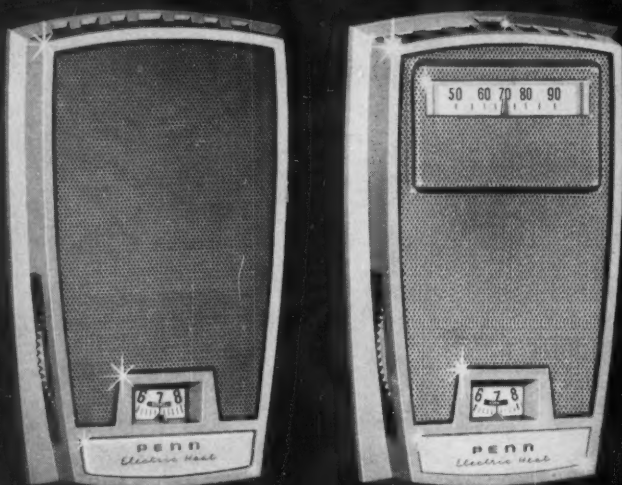
*"After all these years, the breaker's never been opened."*



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## ELECTRIC HEAT THERMOSTATS



### Take your choice...you and your customers will like either one!

Whether you choose the model with or without the built-in, bimetallic thermometer, *you'll like this thermostat because it's easier and faster to install . . . your customer will like it because it has extra convenience in setting temperatures accurately . . . each "click" of its large dial is a change of 1°.*

*You'll both like it because it responds faster to temperature changes, holds temperature closely to selected level, and has the dependable performance that results in complete satisfaction.*

Slim flat front with no protrusions, the Series 800 thermostat extends only  $\frac{13}{16}$ " from the wall. Its modern styling blends in perfectly with any room decor. Get the full story, write for free Bulletin.

**PENN CONTROLS, INC.** Goshen, Indiana

EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N.Y.

AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING,  
APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES



eration and selection of self-generating 3-phase electric speed measurement systems. Meriam Instrument Co.

(57) LIGHTING. New 1961 Star Light catalog contains illustrations of fixtures ranging from pull-downs and chandeliers to convenience lighting fixtures, outdoor post lights and lanterns. Thomas Industries, Inc.

(58) SWITCHBOARD INSTRUMENTS. GEZ-3109, 4-pages, describes new line of low cost ac voltmeters and ammeters. General Electric Co.

(59) CONTROL UNITS. for multi-arc welding are described in 4-page bulletin. J. B. Nottingham & Co., Inc.

(60) LIMIT SWITCH. Bulletin B-30 describes new heavy-duty, metal-enclosed, precision snap-acting switches. Unimax Switch Div., The W. L. Maxson Corp.

(61) TWO-WAY RADIO. Bulletin ECR-816 describes new table model base station two-way radio. General Electric Co., Communication Products Dept.

(62) STAND-OFF FASTENERS. 20-page booklet "What You Should Know About Stand-Off Fasteners" contains information on all types of stand-off fasteners, used to support tubing, wire bundles, conduit, equipment and instruments. Western Sky Industries.

(63) CONNECTORS. 2-page product information bulletin describes new line of multiple circuit connectors, called AMPEEZ. AMP Inc.

(64) VOLTMETER. Bulletin GEZ-3254, 2-pages, describes features and application of new expanded-scale voltmeter. General Electric Co.

(65) FLUORESCENT FIXTURES. Brochure V-602A covers the line of commercial and industrial lighting fixtures, recessed shallow troffers and air-handling troffers plus trans-lighted ceilings featuring plastic panel and louvered shavings. Sylvania Electric Products Inc.

(66) AIR-HANDLING TROFFERS. New folder V-260 covers new and complete air-handling troffer line with application information, air-handling and photometric data provided for typical units. Sylvania Electric Products Inc.

(67) MERCURY VAPOR LAMPS. 28-page technical booklet called "Mercury Lamps" contains information on nearly all phases of mercury

lamps including light output, life ratings and electrical and physical characteristics. Westinghouse Electric Corp., Lamp Div.

(68) **ELECTRICAL EQUIPMENT.** 32-page general catalog and estimating guide covers line of electrical control and distribution equipment. Empire Electric Products Co., Inc.

(69) **RECESSED LIGHTING.** Bulletin A describes new line of fluorescent shallow line troffers. Benjamin Div., Thomas Industries Inc.

(70) **CONTROLLED ELECTRICAL POWER.** 16-page static power conversion guide explains new field of controlled electrical power. Hamilton Standard Div., United Aircraft Corp.

(71) **LIGHTING.** Folder describes Blak-Ray black light lamps and fluorescent materials for garden lighting. Ultra-Violet Products, Inc.

(72) **CIRCUIT BREAKERS.** Bulletin 4300-1A, 10 pages, illustrates complete K-Don line of current limiting circuit breakers and switchgear. I-T-E Circuit Breaker Co.

(73) **COLOR-CODED KITS** for modifying control relays are described in Booklet PL 12-35-960, 8 pages, entitled "Clark Controller Color-Selective Conversion Kits for the 'PM' Relay Line." The Clark Controller Co.

(74) **AMPLIFIERS.** Catalog S-1169, 16 pages, illustrates major products of servo amplifier line for both military and industrial applications. Magnetic Amplifiers Div., The Siegler Corp.

(75) **PACKAGED CONTROLS.** Bulletin GEA-6334A, 8 pages, describes Pan-A-Trol panels for use with machine tools, textile machinery, pumps, materials handling equipment, presses, air conditioning, agricultural machinery, etc. General Electric Co.

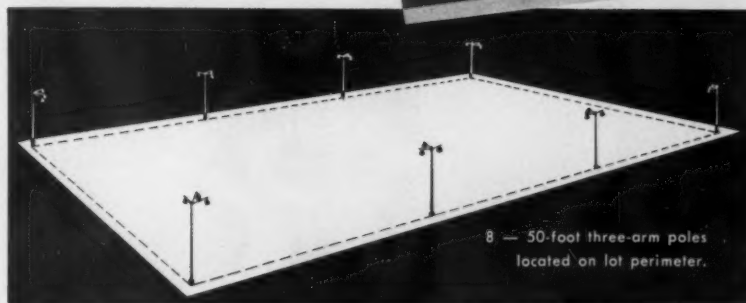
(76) **POWDER ACTUATED TOOLS.** File folder containing data prepared by member companies provides a basic brochure describing products for fastening wood to concrete, steel to concrete, and steel to steel. Powder Actuated Tool Manufacturers' Institute.

(77) **SILICONES.** One-page bulletin CBS-264 describes a variety of uses of different silicone materials and ways that they can be employed to solve plant operating and maintenance problems. General Electric Co.

**NOW...**

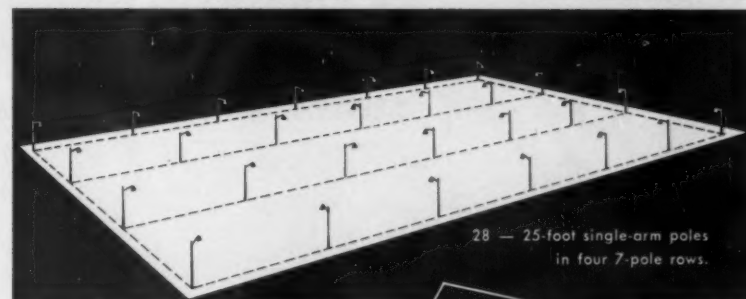
**THOMPSON**

*presents  
lighting  
efficiency  
with built-in  
savings!*



8 — 50-foot three-arm poles located on lot perimeter.

## 8 50-FT. servisafe POLES OUT PERFORM



28 — 25-foot single-arm poles in four 7-pole rows.

## 28 25-FT. UNITS!

Safer, more efficient outdoor illumination is now possible at greatly reduced installed-cost. Lights mounted on 50-ft. poles cover more than three-times the area covered by those on 25-ft. units. And ... there's no need to invest in trucks and telescopic carriers because maintenance men can disconnect and lower fixtures for servicing in complete safety with both feet on the ground.

*check*  
**THESE OUTSTANDING SAVINGS!**

- ✓ BETTER OVERALL LIGHTING
- ✓ LOWER INSTALLATION COSTS
- ✓ 50% LESS TRENCHING
- ✓ 50% LESS WIRING
- ✓ NO AREA OBSTRUCTIONS
- ✓ BETTER APPEARANCE
- ✓ LESS GLARE
- ✓ EASY MAINTENANCE
- ✓ INCREASED SAFETY



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*Request the full story... specifications... costs and installation details.*



**ISOLATED INSTRUMENT COMPARTMENT WITH SEPARATE DOOR**

**MOST COMPACT AND ACCESSIBLE SWITCHBOARD AVAILABLE**

**BREAKERS CAN BE DRAWN OUT WITHOUT OPENING DOORS**

## **NOW YOU CAN ALWAYS, have fast, safe operation of your**

Stored energy closing is just one of the many big progressive steps forward you will find in this all-new I-T-E 13.8 kv switchgear. So is the separate, isolated instrument compartment . . . and the closed door drawout . . . and the more compact switchboard! Here is new safety, new long life potential, and new greater assurance of uninterrupted service.

One man can handle the entire maintenance job. The breaker is not only smaller, it's significantly lighter—the result of using new, more modern materials. Phase barriers may be easily removed by one man. Arc chutes can be tilted back. The breaker frame may even be flipped over without assistance. With the huge cable makeup area and the easily accessible bus, this is truly the easiest to maintain 13.8 kv switchgear yet.





**DESIGNED EXCLUSIVELY FOR STORED ENERGY**

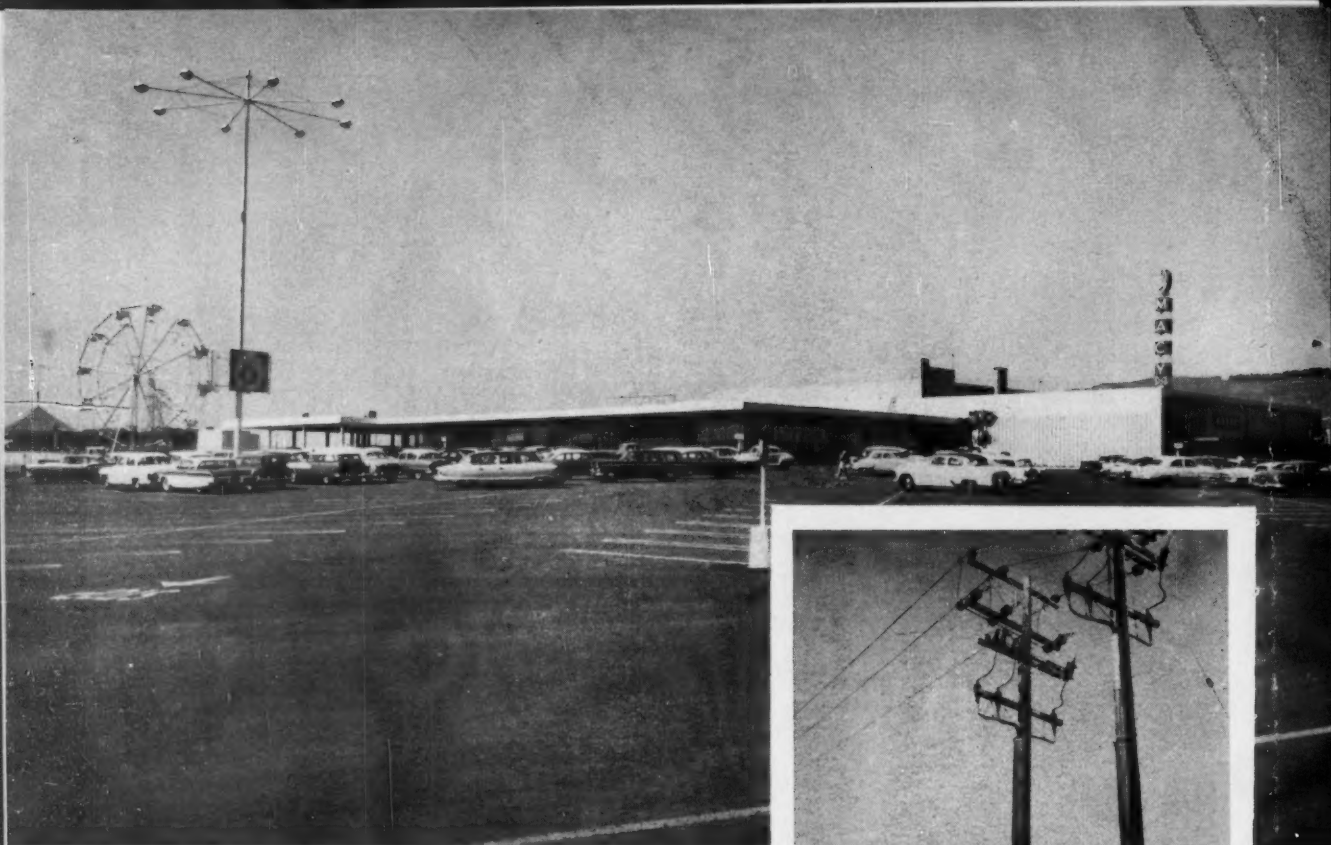
## **ALWAYS, IN ALL WAYS**

**13.8 kv circuit breakers every time**

If you are about to specify new 13.8 kv switchgear, make sure you get all these I-T-E advantages. And right now send for illustrated Bulletin 2800-2B, with complete details. Or contact your nearby I-T-E sales office. I-T-E Circuit Breaker Company, 1900 Hamilton St., Philadelphia 30, Pa.

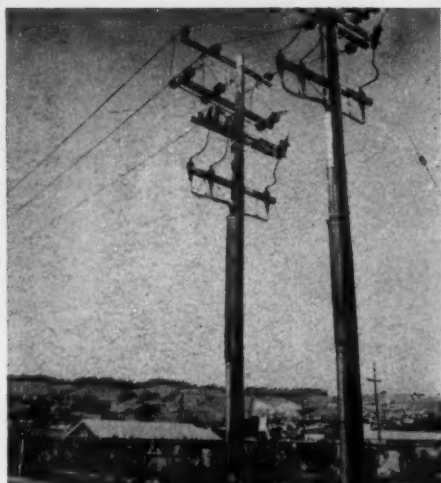


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This "king size" service entrance consists of two parallel 12,000-volt Okolite-Okoprene (oil-base insulated with neoprene jacket) cables which feed the load center.



## Shopping centers buy Okolite-Okoprene for electrical systems that pay for themselves

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The two centers — the Bay Fair in San Leandro and the Valley Fair in San Jose — have installed their own 12,000-volt systems using Okolite-Okoprene cable. They buy their power wholesale, sell it retail to their tenants and amortize the installation and maintenance costs of the systems.

The consulting firm of Dudley Deane and Associates was responsible for this project. Their vice president and chief engineer commented, "The key to a system like this is top-quality premium cable. A

shopping center just can't operate without power, and a shutdown of even a few hours can be expensive. The contractors chose Okolite-Okoprene for these two systems, and we were certainly happy to go along with the decision. We know it will do the job. The present load of each center can be increased at least 50% as these centers grow. We had to insist on premium cable such as Okolite-Okoprene that would handle the power load, yet stand up for years."

What Okolite-Okoprene is doing for these centers, it can do for *your* vital installations. The reason is Okonite Cable'bility\*. For complete details write for Bulletin EC-1085, The Okonite Company, Subsidiary of Kennecott Copper Corporation, Passaic, N. J.

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7739



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# Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay \$5.00.

## Lift Truck Batteries

**QUESTION T38**—We have a question about battery-operated fork lift trucks. In changing from one type to another, space is a limiting factor.

What happens if we change from a 36-volt battery to a 32-volt battery in a fork lift truck originally designed for 36 volts? Will the motor draw more current under normal load, therefore requiring a battery of larger capacity? Will there be any gain whatsoever in changing from a higher voltage, lower capacity to lower voltage, higher capacity?—J.A.M.

**ANSWER TO T38**—If the motor in the fork lift truck was originally designed for 36 volts and you now operate it at 32 volts, the motor will very definitely draw more current. It will be found that the batteries will not last as long if they have the same ampere-hour grading as previously.

As a matter of fact, there is no gain whatsoever in changing from a higher voltage to a lower voltage. Generally speaking, it is the reverse that is better. The motor at the lower voltage will draw more current, and therefore will tend to arc more at the brushes. Furthermore, the motor will tend to overheat with the same capacity of load. Again, the contactors will be carrying more current and therefore they will tend to burn out quicker than at the higher voltage.—H.H.S.

**ANSWER TO T38**—You will be better off to buy a correct size battery in order to get the full hp rating of the motor. The motor will start and run on the 32 volts but for the same hp you will need more amps. The weight of the battery must be correct since the battery is probably used as a counterbalance. To verify this, you should discuss the matter with the manufacturer of the fork lift truck, and perhaps a major battery manufacturer.—H.S.

## Capacitor Motors

**QUESTION U38**—On a 115-volt air conditioner unit where or what would generate 220 volts across the

starting relay coil? It is a 1½-hp unit with load amps of 10.4. When plugged into 115 volts it draws 7 amps with 220 volts across the relay. When the starting circuit wire is removed from the compressor while running, the voltage drops to 115 volts across the coil and the amps go up to 10.

The unit consists of a compressor, fan motor, starting relay, 15 mf running capacitor, and an electrolytic capacitor.—C.H.

**ANSWER TO U38**—You will find a step-up transformer (1) in the motor using the motor laminations, (2) in the capacitor container, (3) in the relay container or in a separate container. This is possibly the reason for the 220-volts in the normal starting circuit.—H.S.

**ANSWER TO U38**—From your partial description of the air conditioning unit, it is likely that the motor is a capacitor-start, capacitor-run type. The auxiliary winding is opened by the relay you speak of when the motor has reached about 75% of synchronous speed.

Since the size of the starting capacitor is inversely proportional to the voltage, it is desirable to keep the starting-winding voltage fairly high. For this reason, some manufacturers wind all motors for 220 volts on the starting winding and supply a small transformer for this winding when the motor is to be connected to a 110-volt supply. This procedure has another advantage in that the same capacitor and control equipment can be used for all applications.

The use of the 15 mf capacitor in the circuit while running is to increase the efficiency and power factor. Also it makes the motor run more quietly.

Because of the many different ways of connecting the foregoing components, any diagram would probably not be the same as your particular hookup. If you want a definite answer, I suggest that you write to the manufacturer as to the type of motor with special attention to a schematic of how the starting and running windings, autotransformer, relay, relay contacts and the two capacitors are connected. This would immediately show where the 220 volts come from.

Without further information, I can only venture a guess that the relay coil is connected in the 220-volt starting winding circuit. When you disconnect the one leg of the starting winding, you are only getting the induced voltage (110 volts) produced by the rotating magnetic field of the motor. This also disconnects the running capacitor, lowering the efficiency and power factor; hence the increase in the running current.

A closer examination of the unit should reveal something along this line, but to be positive, write to the manufacturer.—J.W.

## Third Harmonic Currents

**QUESTION V38**—I understand that a perfectly balanced fluorescent lighting load fed by a 3-phase, 4-wire system will have current flow in the neutral. How can I calculate the magnitude of this neutral current in order to choose the size of the neutral? How will this neutral current affect the voltage-drop in the feeders?—H.M.

**ANSWER TO V38**—The actual calculation of third harmonic current flow due to fluorescent lighting would be a time consuming task. Studies of this problem have shown that third harmonic phase current can be as high as 30% of the fundamental frequency current; therefore, the resulting neutral harmonic current approaches 100%, and for this reason it is recommended that 100% capacity neutral conductors be used. For voltage drop calculations it would be wise to increase the fundamental voltage drop calculations by one-third to be on the safe side.—C.W.M.

**ANSWER TO V38**—If we take a 3-phase load and have a balanced load on it, then theoretically there should be no current in the neutral. This, however, is only true where the current is a true sine wave. Where the wave form is distorted, then mathematical analysis will show that there will be a third harmonic current flowing in the neutral which will be about three times the phase current. In other words, the fundamental of the 3-phase cur-





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## How Day-Brite lighting "sells" reading in the new Pius XII Memorial Library

From the architect's first draft to the final choice of curtains, St. Louis University's modern new library was planned with one goal in mind: to encourage students to *use* it.

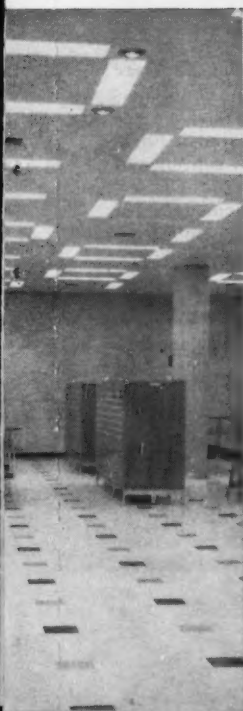
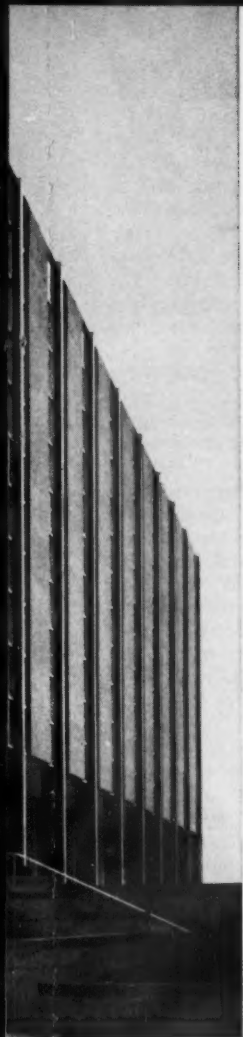
Self-service, open-type book shelves were used to invite "browsing" among the stacks. "Wide-open" interior design helped create a pleasant atmosphere. In addition, comfortable bright-colored furniture was contrasted against light-colored walls and a noiseless cork floor.

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rents cancels out for the first harmonic but adds mathematically for the third harmonic.

If you want to determine the magnitude of this harmonic current it will be necessary to get a wave form analysis from the manufacturer of the particular fixture and ballast that you are using. The point is that some manufacturers will have a more seriously distorted wave form than others.

There is another important point to observe and it is that this wave form is seriously dependent upon the line voltage. With an increase in voltage, the ballast will tend to saturate more and, therefore, will distort the wave form more. As a first approximation, I would say that the third harmonic in each phase should not exceed 30%. This would indicate that the actual neutral current should be considered as three times this, something in the order of the same as the phase current.—H.H.S.

**ANSWER TO V38**—The flow of current in the neutral of a 3-phase, 4-wire system supplying electric discharge lighting is the result of a third harmonic frequency generated by the inductive ballasts and the discharge arc, and will be approximately equal to the phase current.

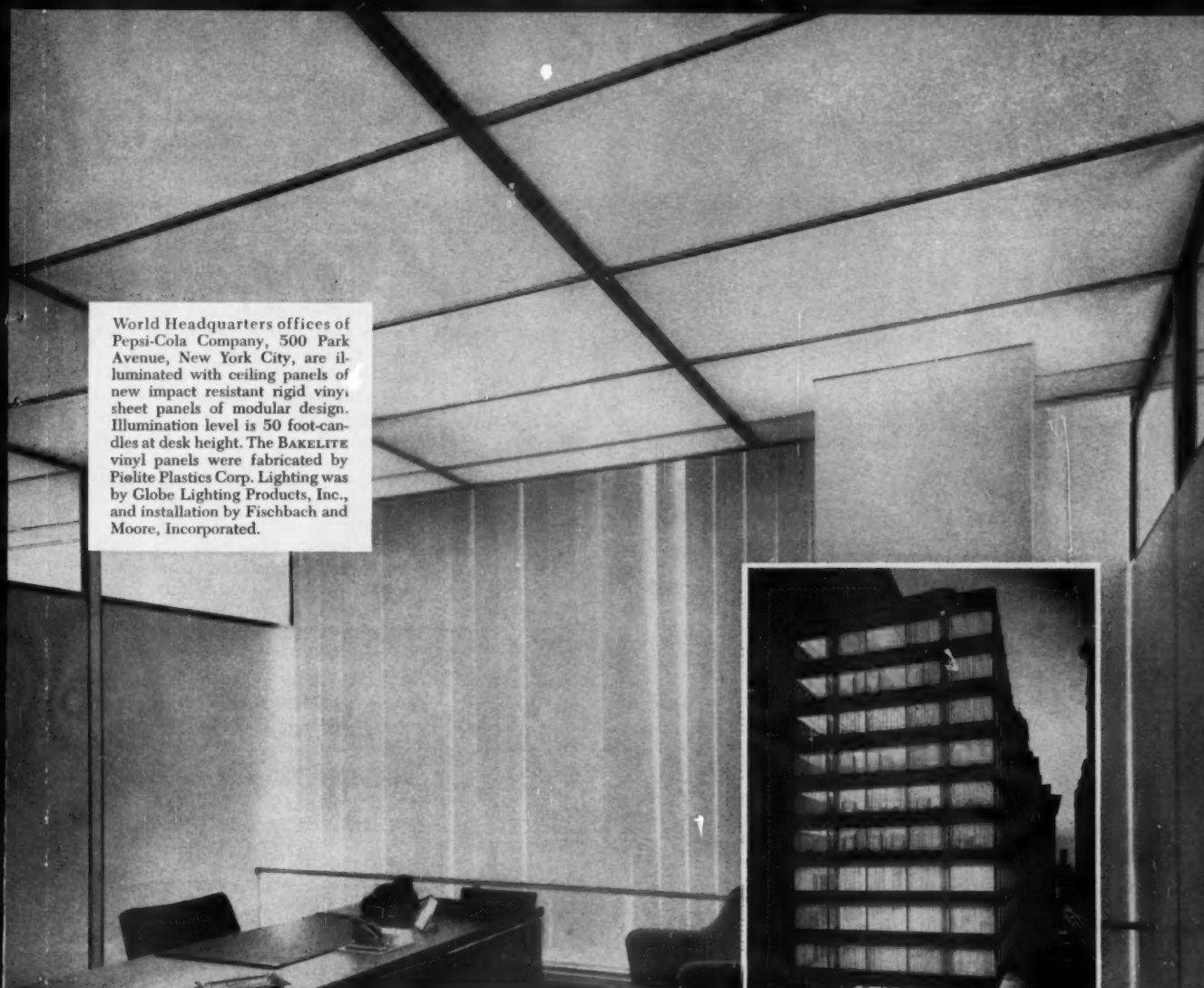
The calculation of its magnitude would serve no useful purpose since the size of the neutral is established by the National Electrical Code, which I assume would be the guide for any installation contemplated.

If H.M. has in mind a branch circuit as covered by Article 210 of the code, the neutral will of necessity be the same size as the phase conductors. If he has in mind a feeder as covered by Article 215 of the code, the neutral should be sized accordingly. The only conditions affecting the choice of size of the neutral conductor is given in Paragraph 220-4(d) the last sentence of which states: "There shall be no reduction of the neutral capacity for that portion of the load which consists of electric discharge lighting."  
—W.L.D.

### CAN YOU ANSWER These QUESTIONS?

**QUESTION D39**—The polarity of an ordinary electromagnet changes with the direction of current flow. If direct current is applied to the coil, and if the flow direction of this current is allowed to remain fixed, there will be no change in

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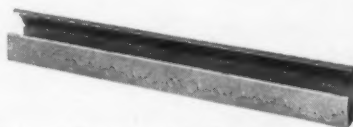
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polarity. Therefore, the magnet in holding the plunger of a solenoid or clapper of a contactor, would exert a constant, uninterrupted pull on the plunger or solenoid. This is understandable. However, in alternating current, since the direction of current flow reverses with each cycle, it would seem that the change in current flow would produce a series of attracting and repelling forces that would neutralize each other thus making the forces on the plunger ineffective. I am aware that shading coils are used to offset the conditions produced by the zero voltage effect of ac current; but what is done in the winding of an ac magnet coil to maintain the pulling force always in the same direction during changes in the alternating current flow direction. This has always puzzled me. In addition to your answer, I would appreciate your giving me the name of a book treating on this subject.—C.H.M.

**QUESTION E39**—What is a proximity switch? How does it work and where is it used?—R.C.

**QUESTION F39**—We have heard that there is an apparatus for converting power to a double frequency, say 120 cps from 60 cps supply. This apparatus is not a rotary equipment or motor-generator set, neither a mercury or other type electronic converter, but is an entirely magnetic converter.

Would like information on the principle of the apparatus, range of voltages and capacities available, and if possible, names of manufacturers.—F.G.

**QUESTION G39**—We are in the throes of making a power factor correction on our power distribution system. The need was determined by a preliminary investigation. Our original one problem (need for capacitors) has expanded into four problems (where to locate capacitors).

With our power distribution system, we have four places that we can locate the capacitors: 1. at the load; 2. at the bus duct feeding a group of individual loads; 3. on the secondary side of our transformers (480 volts); 4. on the primary side of our transformers (4160 volts). Where is the best location for the capacitors?—J.A.M.

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YOUR ANSWERS BY FEBRUARY 15**





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# Questions on the Code

Answered by:

**B. A. McDONALD**, New York Board of Fire Underwriters, Rochester, N. Y.

**B. Z. SEGALL**, Consulting Electrical Engineer, New Orleans, La.

**R. E. WARD**, Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.

## Armored Cable

**Q.** Noting that Section 710-3 permits armored cable to be used for voltages in excess of 600 volts, what installation requirements are applicable and what article applies?—A.M.

**A.** In Section 334-3 reference is made to the use of armored cable for installations rated over 600 volts, viz, Sections 710-3 and 710-32.

Section 710-3 gives the general approval for the installation of "metal armored cable suitable for the use and purpose" in circuits rated over 600 volts.

Section 710-32 permits the installation of metal armored cable in an installation rated over 600 volts if the cable is accessible to qualified persons only.

Therefore, all the rules of Article 334 are applicable to installations rated above 600 volts when armored cable is used in these locations. It should be noted that Section 334-3 permits conductors smaller than No. 4 when these are installed in industrial and commercial occupancies when the wiring is operated at voltage in excess of 600 volts—B.Z.S.—1/61/1

## Wiring Range Components

**Q.** Reference is made to the 1959 NEC, Section 422-13, Ovens and Counter Mounted Cooking Units. Does this mean that each unit must be on a separate circuit and have a separate disconnecting switch?—J.E.R.

**A.** For the convenience of our readers the above code rule is quoted as follows:

"422-13 (a). Wall-mounted ovens and counter-mounted cooking units complete with provisions for mounting and for making electrical connections shall be considered as fixed appliances."

This rule merely states that such cooking units are considered to be fixed appliances which may be served through a plug and recepta-

cle connection that is not considered to be the disconnecting means. There is no clause in this rule or any other code rule which requires a separate circuit to each unit. Reference to the provisions of Section 210-19 indicates that such cooking units may be connected to a 50-amp branch circuit through taps no longer than necessary for servicing. The provisions of Section 210-24(c) also recognize the connection of fixed cooking appliances to a 50-amp circuit through a cord connection.

According to Section 422-16 (b) the 50-amp branch-circuit switch or circuit breaker may, where readily accessible to the user of the appliance, serve as the disconnecting means. In dwelling occupancies, other methods of disconnect may be applied as covered by Section 422-17. For further details see page 104 of the June issue of EC&M.—B.A.McD.—1/61/2

## Electric Heating Cable

**Q.** Can electric heating cable, when installed according to NEC Article 422, be used in the concrete floor of a paint spray room where all connections to the non-heating leads are made outside the hazardous area?—J.L.R.

**A.** Yes. The floor cable, if a listed product, installed according to Article 422, will not heat a floor to the danger point that would cause ignition to paint spray residue and material. The cable is completely covered and sealed by the concrete with no possibility of an explosive paint residue reaching the cable. For this reason, I base my answer on a broad interpretation of Sections 516-2(c) and 516-3(c) of the 1959 National Electrical Code. Section 516-2(c) would allow the classification of non-hazardous as the concrete would certainly prevent the accumulation of hazardous vapors reaching the heating cable, and would be classed as sealed away from such an accumulation. Section 516-3(c) will allow the separation of lighting from the hazardous area by a panel when

it effectively isolates the hazardous area from the lighting unit area. Therefore, using the same principle of reasoning, the concrete would certainly do a better job of isolating the cable from the hazardous area than a glass or other transparent panel material.—R.E.W.—1/61/3

## Hazardous-Areas-Process Plants

**Q.** Much of our work consists of engineering and construction of process plants which use hexane as a solvent. According to Article 500 NEC, areas using this type of solvent shall be classified as "Class I, Group D, Hazardous Location." To avoid the use of the expensive electrical equipment approved for use in these areas, we establish a non-hazardous room or house within the hazardous area allowing the use of general purpose control equipment.

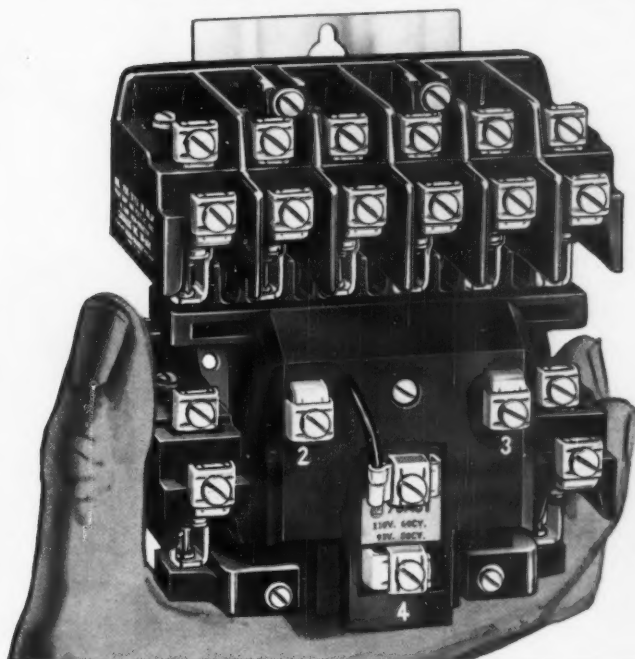
The code does not specifically spell out what the boundaries should be separating the hazardous from the non-hazardous areas. We usually provide a control house outside the solvent extraction building elevated to a height of 10 ft above grade to avoid the entrance of the heavier-than-air hexane vapors.

Can you specifically define the hazardous area within which it would be unsafe to house general purpose (NEMA I) control equipment inside a non-pressurized house? In other words, how close to the extraction building can I locate the control house and what is the minimum height above grade?—E.K.

**A.** According to the flammable liquids and gases code of the National Fire Protection Association, (Vol. I of their National Fire Codes), the characteristics of hexane are somewhat similar to gasoline. In fact, UL classifies hexane with respect to "Fire Hazard Only" as 90-95 while gasoline is classified as 95-100. This is further verified by the fine print note following Section 500-2 of the NEC which for the purposes of testing and ap-



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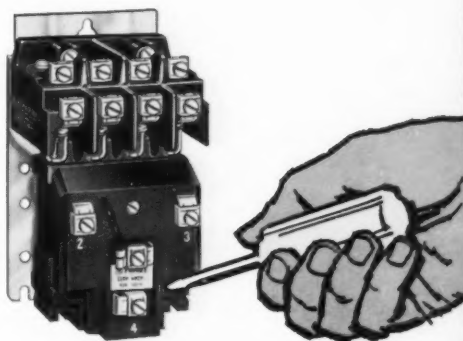
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# Where Reduced Voltage Motor Starting is Necessary...

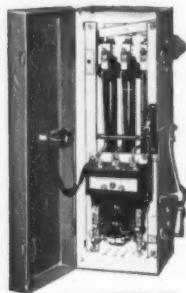
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**AUTOMATIC AUTOTRANSFORMER** starter for squirrel cage motors that should not be started at full voltage. The autotransformer reduces line voltage during acceleration. Taps permit adjustment of voltage applied to the motor.

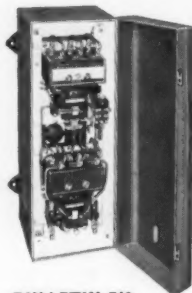


BULLETIN 740



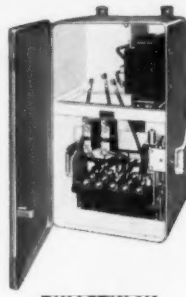
BULLETIN 640

**MANUAL STEPLESS RESISTANCE** starter has graphitic compression disc resistors for velvet smooth starting of squirrel cage motors. Starting of the motor is under the complete control of the operator.



BULLETIN 740

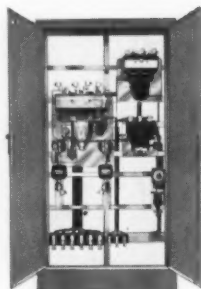
**AUTOMATIC RESISTANCE** starter has graphite resistors automatically inserted in series with the squirrel cage motor at starting. Resistors can easily be adjusted to motor and load conditions, giving velvet smooth acceleration.



BULLETIN 646

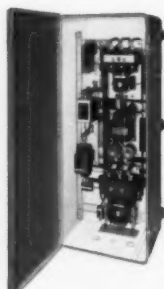
**MANUAL AUTO-TRANSFORMER** starter for use where load conditions or power company rules require reduced voltage starting. The air break starter shown has double break, silver alloy contacts.

**AUTOMATIC MULTIPPOINT RESISTANCE** starter for use on network systems. Resistors inserted at starting are cut out in definite steps. Time intervals adjustable to provide velvet smooth starting.



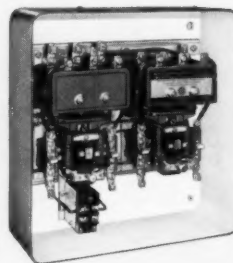
BULLETIN 741

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2-61-RM

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proval classifies both gasoline and hexane as Group D atmospheres.

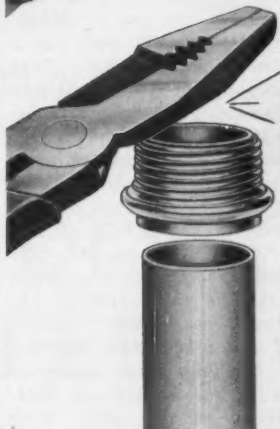
It is also significant to note the fine print note following Section 500-1 which suggests that some of the arc and heat producing electrical equipment be located in a non-hazardous area. Also the reference to NFPA standards may be of assistance in the classification of various areas with respect to hazard. Chapter 8 of NFPA No. 30 covers the use of flammable liquids in processing plants such as described by your question. This code, however, does not cover the extent of hazardous areas. As a result, the authority enforcing the code has the responsibility for determining such areas in accordance with existing conditions. In view of the many variables involved, it would be difficult to develop a set of rules common to all types of process plants. The NEC under Articles 510 through 516 has established the character and extent of hazardous areas in occupancies such as garages, service stations, bulk-storage plants, etc. Such code rules, not only facilitate the work of the inspector and design engineer, but they eliminate the inconsistent concept of general rules, and promote safe uniformity. As time passes on, it is quite possible that other types of hazardous occupancies will be covered in a similar manner.

In view of the foregoing, one cannot define the hazardous areas of your process plant without a survey of the plant and all pertinent factors involved. In some instances the local Fire Department or the Superintendent of Buildings assumes the responsibility for determining such hazardous areas, and the electrical inspector determines the nature of electrical wiring and equipment suitable therefore. Consultation with the pertinent Fire Insurance Rating Organization should be held. The Insurance Company covering the risk should be consulted since they may wish to supplement any federal, state or local regulations which may be involved. The use of a combustible gas indicator, under various conditions of plant operation, would be helpful in deciding the extent of hazardous areas. To me this is the procedure which should be followed when specific answers to your questions are desired. In the absence of specific authoritative advice there appears to be no alternative. This opinion appears to be verified by Official Interpretation No. 277, issued June 4, 1942. It is quoted as follows:



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"Statement: A small building is used exclusively for housing gasoline, diesel fuel oil and kerosene pumps. Such buildings are frequently found in the very near vicinity of large storage tanks as the bulk and wholesale plants of oil companies.

"Question: Should such a building, so located, be considered as a Class I, Group D hazardous location?

"Finding: Section 5001 contemplates that the authority enforcing the code shall determine when a particular premise or installation of apparatus conforms to the code description of a hazardous location. Generally speaking, close proximity to a bulk station warrants classification of an electrical equipment as in a hazardous location. Not all pump houses need be so classified. The final responsibility for classification rests with the enforcing authority."—B.A.McD.—1/61/4

## Electric Heater Clearances

**Q.** In a residence with an electric baseboard heater, what clearance is required, or what is the recommended distance for drapes or curtains from such baseboard heater?—H.W.

**A.** Section 422-6 of the 1959 NEC reads as follows:

"Protection of Combustible Material. Each electrically heated appliance that is obviously intended by size, weight and service to be located in a fixed position shall be so placed as to provide ample protection between the appliance and adjacent combustible material."

This section comes as close to answering your question as any that I know in the NEC. Some manufacturers advertise that curtains or drapes can be placed directly against their baseboard heaters. However, I have made personal investigations where drapery material hung against or over baseboard heaters and scorched the drapery to the point that it had to be replaced. I have discussed this with representatives of some manufacturers and have read their recommendations concerning your question. One manufacturer recommends that drapes or curtains be hung at least 10 in. from the floor, which would be something like 3 or 4 in. above the baseboard heater. One other manufacturer recommends a clearance of 6 in. From my

experience, I recommend that all drapes or curtains be kept at least 3 or 4 in. away from the openings in baseboard heaters. We have had cases where the circulation of air through the baseboard heaters has been blocked by the placing of a rug at the bottom of such heater, and when this happens, the temperature will rise.—R.E.W.—1/61/5

## Multi Speed Motors

**Q.** Section 430-51. A 2-speed motor is used for air conditioning (not a package unit nor is it a sealed hermetic type). Each speed is supplied by a magnetic controller (twin controller in the same enclosure) equipped with thermal overcurrent devices rated properly for the full-load rating of the separate speeds, and there may be considerable difference in full-load ratings at the different speeds. The motor is supplied by one branch circuit, if that is the intent of the code, when these separate speeds are used for other than starting purposes, carrying their respective full loads for necessary times. Reference is to motors other than wound-rotor type.

What branch-circuit protection is required or permitted, assuming one branch circuit is permitted? How are the conductors between the controllers and the motor determined?

If the conductors between the controllers and the motor may be selected at 125% full load for the respective speeds and the branch-circuit conductors are protected at the starting current of the highest rating, what protection is afforded the smaller conductors between the controllers and the motor?—A.M.

**A.** The Code does not specifically give an answer to this problem. As pointed out in the above statement this motor is served from a single branch circuit and feeds a controller which is arranged to operate the motor at two or more speeds.

Generally the motor controller provides overload protection—motor-running overcurrent protection—for each speed setting. This is usually the two-unit type of protection (assuming a 3-phase motor) but full protection may be obtained since many of these controllers may be provided with an overload unit in each ungrounded conductor for each speed range. So that under all conditions of operation, proper protection

is provided during normal running conditions.

The full-load current will vary almost directly with the speed. Thus, for example, a 2-speed 1800/900 rpm motor will have about one-half the full-load current at the 900 rpm speed as it will have at the 1800 rpm speed. Under these conditions the conductors between the controller devices and the motors may be designed on the basis of these two different full-load currents since the conductors will be properly protected for running conditions. So in effect, one set of conductors for one speed may have almost twice the current-carrying capacity as those in use for the second speed range. Both sets of conductors, of course, must be based on a minimum of 125% of the full-load currents at the respective speeds.

With respect to the main branch circuit from the motor-branch-circuit short-circuit and ground-fault protective devices to the motor controller, the design must be based on the maximum full-load conditions; i.e., full-load-current for the maximum speed. Short-circuit protection is thus properly supplied for these main branch-circuit conductors and the sub branch-circuit conductors feeding from the high-speed running overcurrent devices in the motor controller to the motor itself. The other sub branch circuit from the low-speed running overload devices in the controller to the motor is, of course, not properly protected. However, the low-speed running overload devices will definitely "blow" if a short circuit or ground occurs in this sub branch circuit.—B.Z.S.—1/61/6

## Transformers

**Q.** Under Section 450-23 in the 1959 NEC, "Askarel-Insulated Transformers Installed Indoors," reference is made to connect the pressure relief vent to a chimney or flue. If no flue is available, what type of vent, or other means, should be used? How is it sized?—L.G.W.

**A.** According to my information, the manufacturers of askarel-insulated transformers in the larger sizes have incorporated a relief diaphragm in the top of the transformers. This diaphragm operates by pressure, and should pressure build up and open the diaphragm, the fumes would be re-

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leased through the vent; and for this reason it is necessary, or at least desirable, that such fumes be directed to an outside location when the transformer room is not ventilated. When no chimney or flue, such as is mentioned in the NEC, is available, a flue or other acceptable means shall be provided; such flue may be a pipe of a size at least equal to the opening in the top of the transformer where the relief diaphragm is located. One manufacturer's representative stated that his company recommended a regular galvanized or iron pipe with a pipe flange to be installed at the place provided for such, and that the pipe would be the same size as the opening. Some manufacturers have incorporated a device in their transformers that will absorb any gases generated by arcing inside the transformer case. This type does not require venting.—R.E.W.  
—1/61/7

**Flexible Conduit**

**Q.** Part of Section 350-3 states: "(3) Connections not over 48 in. in length, or larger on approved assemblies, to equipment where the use of ½-in. or larger size flexible conduit is not practicable, in which case flexible metal conduit of ½-in. electrical trade size may be used."

We have an installation of duplex receptacles and toggle switches mounted in standard flush outlet boxes which are installed on metal partitions which are filled with asbestos insulation. The partitions are also reinforced with steel which makes pulling in conduit difficult. The ½-in. flexible metal conduit is a lot easier to install with a tool which we designed to make a path from the top of the partition to the outlet box for the ½-in. flexible conduit. Would our interpretation that ½ in. is not practicable in this approved assembly (metal partition) be correct?—G.E.L.

**A.** Section 350-3 under Article 350—Flexible Metal Conduit states:

"Minimum Size. No flexible metal conduit less than ½-in. electrical trade size shall be used except (1) as permitted for underplaster extensions by Section 344-2; (2) as permitted for motors by paragraph 430-145(b); and (3) for connection not over 48 in. in length, or longer on approved assemblies, to equipment where



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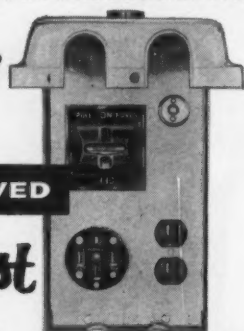
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the use of  $\frac{1}{2}$ -in. or larger size flexible metal conduit is not practicable, in which case flexible metal conduit of  $\frac{1}{2}$ -in. electrical trade size may be used."

I would consider that under the conditions you describe, an inspector would be consistent with the intent of this section to accept the  $\frac{1}{2}$ -in. flexible conduit if other conditions of the code are met.—R.E.W.—1/61/8

### Neutral Size

**Q.** In the second paragraph of Section 220-2 is it the intent that the grounded neutral conductor of such branch circuits be increased 25% when multi-wire branch circuits are installed?—A.M.

**A.** Yes. Under certain conditions of unbalanced load and also when one of the multi-wire branch-circuit overcurrent devices "blows," the neutral conductor is basically a circuit conductor. It, therefore, may be required to carry the maximum load for a "long period of time."—B.Z.S.—1/61/9

### Conductor Fill in Conduit

**Q.** The NEC explains in the tables showing number of conductors that may be pulled in complete conduit systems, but also states that this table does not apply to short sections of conduit used for protection of exposed wiring from physical damage. Will you please elaborate on this?—F.S.

**A.** Table 1 of the 1959 Code covers the maximum number of conductors which may be installed in a conduit or tubing. As explained in the introduction to Chapter 9, this table applies only to complete conduit or tubing systems, and does not apply to short sections of conduit used for the protection of exposed wiring from physical damage.

The provision of Section 320-12 which covers the protection of open wiring on insulators from physical damage is an example of the intent of the code. Conductors of such a wiring method located within 7 ft of the floor are considered to be exposed to physical damage, and one of the methods of protection recognized is by the use of rigid metal conduit.

The provisions of Section 336-6, covering non-metallic sheathed

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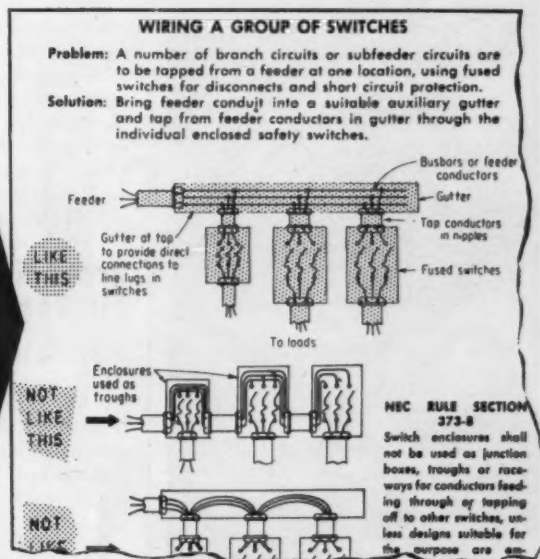
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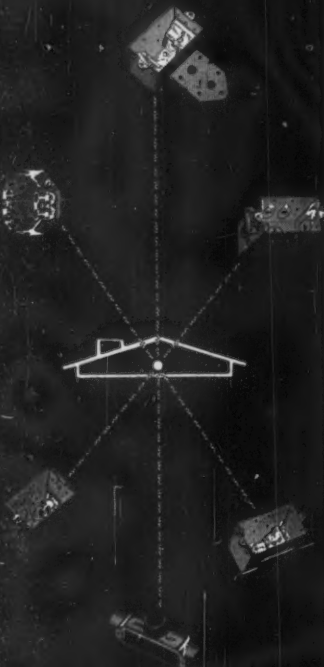
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cable, require it to be protected when exposed to physical damage. One of the methods recognized for protection is conduit. I believe the same reasoning would apply to armored cable when exposed to physical damage.

Under such circumstances Table 1 does not apply. A question occasionally arises concerning the status of short nipples which are used to connect metallic enclosures of a conduit system of wiring. The very nature of the wording of the clause under discussion indicates to me that Table 1 covers such nipples. They are a part of a complete conduit system of wiring.—B.A.McD.  
—1/61/10

## Grounding an Air Conditioner

**Q.** In the installation of a window-type air conditioner, under what conditions should the frame of the air conditioner be grounded, and is it permissible to ground to the neutral conductor of the circuit?—R.S.M.

**A.** Grounding is covered in Article 250 of the NEC, and equipment grounding is covered under Section 250-42. Your question is specifically covered in Section 422-40. There are several conditions under which grounding of an air conditioner such as you describe would be required, and I quote the following that would cover a situation where the window air conditioner was located on an outside wall that would be exposed to the weather.

"1. Where equipment is located in a wet location and is not isolated.

"2. Where equipment is located within reach of a person who can make contact with any grounded surface or object.

"3. Where equipment is located within reach of a person standing on the ground."

There are other conditions under which grounding would be required, such as if the equipment is in electrical contact with metal or metal lath or where equipment operates with any terminal at more than 150 volts to ground. In other words, in practically all instances the code would require window air conditioners to be grounded, especially at the first floor level and could be at locations above the first floor.

In answer to the last part of your question, the NEC does not permit the grounding of air conditioning equipment to the neutral conductor.

The method of grounding is covered in Section 250-57, which reads as follows:

"(a) Metal boxes, cabinets and fittings, or non-current-carrying metal parts of other fixed equipment, where metallically connected to grounded cable armor or metal raceway are considered to be grounded by such connection.

"(b) Where not so connected they may be grounded in one of the following ways:

"(1) By a grounding conductor run with circuit conductors; this conductor may be uninsulated, but where it is provided with an individual covering, the covering shall be finished to show a green color.

"(2) By a separate grounding conductor installed the same as a grounding conductor for conduit and the like.

"(3) By special permission, other means for grounding fixed equipment may be used."—R.E.W.  
—1/61/11

## Appliance Circuits

**Q.** There seems to be some disagreement as to the intention of the new code Section No. 220-3 in our area.

**A.** Is the intention of the code to make it mandatory to have a minimum of two small appliance circuits per service panel serving a residential installation?

**B.** Is it the intention of the code to require two separate small appliance circuits for each of the rooms mentioned?

It is our interpretation that the first is correct.

We would greatly appreciate it if you could give us your view of the subject.—S.S.

**A.** Your question concerns Section 220-3(b); Receptacle Circuits, Dwelling Occupancies, which states:

"For the small appliance load in kitchen, laundry, pantry, dining-room and breakfast-room of dwelling occupancies, two or more 20-amp branch circuits in addition to the branch circuits specified in Paragraph 220-3(a) shall be provided for all receptacle outlets (other than outlets for clocks) in these rooms, and such circuits shall have no other outlets."

I fully agree with your interpretation and point out the wording in these rooms. If the intent was for two separate small appliance circuits for each room, the wording would have been in each room.—R.E.W.—1/61/12



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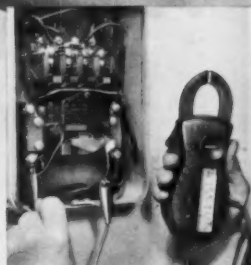
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**AS AN AMMETER:** snapped around conductors to balance circuits.



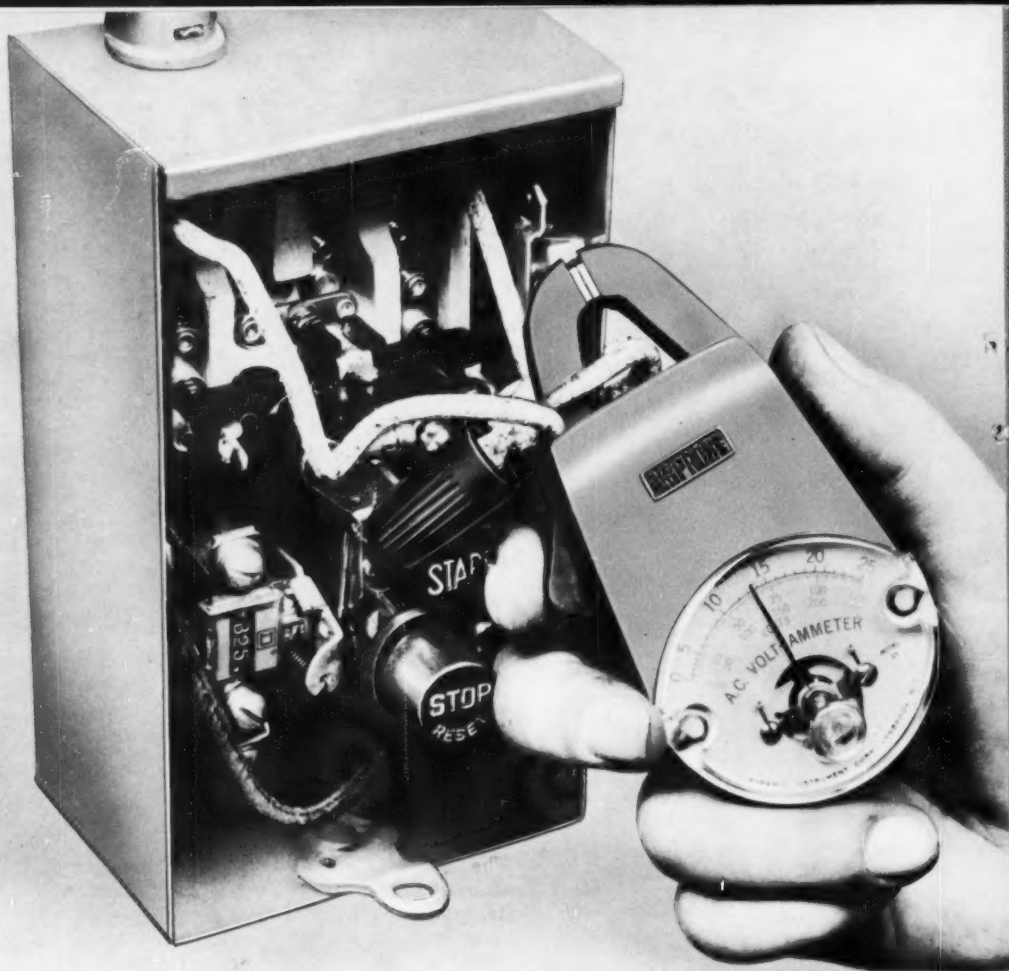
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Does it balance loads, locate grounds, determine motor overloads, check rating of circuit breakers?	YES	NO



**AS A VOLTAGE TESTER:** for checking critical operating voltages.

**AS AN AMMETER** (large photo): reading current at switch box.



**PYRAMID INSTRUMENT CORPORATION, LYNBROOK, NEW YORK** Canada: Atlas Radio Corp., 50 Wingold Ave., Toronto, Ont.

## NYC Code Requires Low-Voltage Pool Lighting

Submersible swimming-pool lighting fixtures have been a concern to most electrical inspection authorities for the past several years. As a result, few inspectors' meetings have failed to include this subject during code discussion periods. Moreover, case histories of electrocutions to persons due to faulty pool lights have intensified concern on the part of inspection authorities.

With this in mind, the City of New York issued a special bulletin that limits the potential of submersible pool lights to 12 volts.

Known as Bulletin No. 17, the new requirement was signed by Armand D'Angelo, Commissioner of the NYC Department of Water Supply Gas and Electricity, and will be enforced by the Bureau of Gas and Electricity.

The full text of the bulletin is as follows:

"Bulletin No. 17

"Rules and Regulations in Reference to the Use of Submersible Lighting for Swimming Pools, Reflector Pools and Display Fountains

(Filed with City Clerk November 10, 1960)

"Pursuant to authority vested in me under Section B30-5.0 of the Administrative Code, the following are Rules and Regulations relating to the use of submersible lighting units for swimming pools, reflector pools, and display fountains.

"17.1 General—Effective as of this date, the use of 120-volt lamps when assembled in submersible lighting units, for the illumination of swimming pools, reflector pools, and display fountains whether they are intended for side wall or pedestal mounting is hereby prohibited.

"17.2 Voltage—The permissible voltage that may be applied to lamps used for such application shall not exceed 12 volts.

"17.3 Transformers—

"a. Step-down transformers used in conjunction with such lighting units shall be of the two-winding, isolating type and having a grounded metallic shield between the primary and secondary windings to prevent accidental contact between windings under fault conditions.

"b. Transformers shall be located remotely from the lighting units which they supply, and overcurrent protection shall be provided in both primary and secondary windings.

"17.4 Swimming pools, reflector pools, or display fountains presently under construction and where the lighting and wiring thereto will be completed by December 31, 1960, will not be affected by this ruling."

In reviewing this new regulation, it is significant to note that the 12-volt pool lighting applies to all types of swimming pools, including large commercial types. Also, primary and secondary overcurrent protection is required for each transformer. And to assure maximum safety, a two-winding, isolating transformer with an inherent metallic grounding shield is required.

## EHV Line Energized To 720 KV

The world's highest electrical transmission line voltage, 720 kilovolts, was applied on December 8 to a portion of the 4½-mile EHV (extra high voltage) line erected by the General Electric Co. near Pittsfield, Mass. The line is a full scale prototype and will be used for the testing and development of

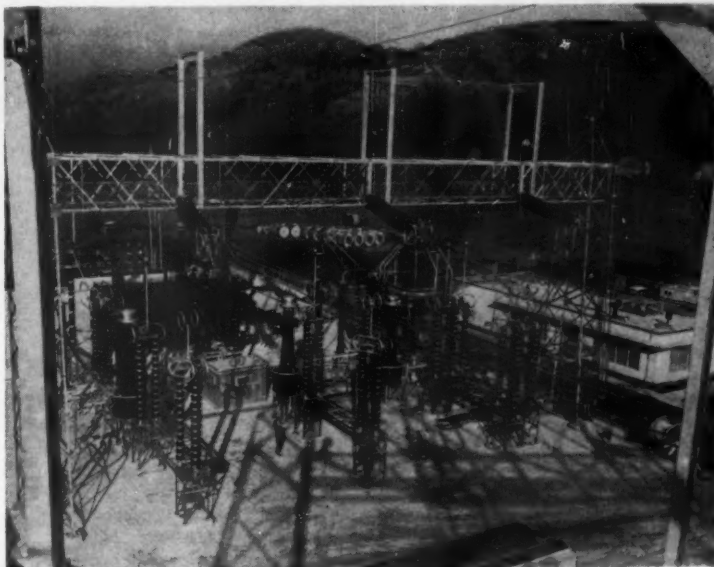
towers, conductors and station equipment under actual operating conditions in the extra high voltage range up to 750 kv.

The purpose of Project EHV is to generate new knowledge which will help make it possible to transmit economically electric power at higher voltages than are now used. A 750,000-volt line can carry much more power than a conventional 115,000-volt line.

The toughest problem in the urgent expansion of transmission capacity for the utilities is the acquisition of the necessary rights of way. EHV promises to provide much higher power transmission capability over existing or moderately widened rights of way.

Project EHV will be operated first at 460 to 500 kv, then stepped up to the 700 kv level in 1962. About 250 instruments are located along the line to measure meteorological, electrical and mechanical data. Readings will be recorded and processed automatically by a scanning device which under normal conditions will sample all measurements in 20-minute intervals. During severe weather conditions scanning is speeded up to a 2-minute interval.

Lightning and switching surge performance, radio interference and corona are among the major problems for which the extensive instru-



**NORTH STATION** of Project EHV powers 750,000-volt transmission line from the transformer through instrumentation gear and giant disconnect switches. The building at the right houses control equipment and an elaborate instrument installation.



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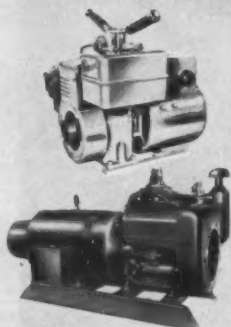
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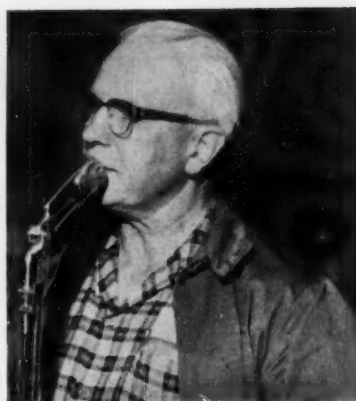


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**CONTRACTOR** James Walker, W-D Electric Co., Inc., Kansas City, Mo., discusses apartment building service techniques from floor of code session at recent Western Section, IAEI convention.

mentations will provide unprecedented quantities of experimental data.

Among the 12 companies cooperating in Project EHV were Stone and Webster, Western Massachusetts Electric Co., Aluminum Co. of America, and U. S. Steel Corp.

The exacting equipment installation and connecting bus work at the terminal station of the novel system was performed by Collins Electric Co., electrical contractors of Springfield, Mass.

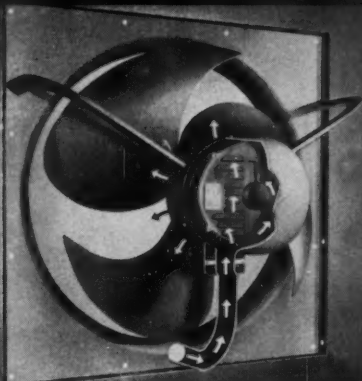
## Heating Rate Cut in Chicago

Lower rates for electric space heating placed in effect November 25, 1960, by the Commonwealth Edison Company, Chicago, are expected to stimulate further growth of electric house heating on this utility's lines.

Under one rate revision authorized by the Illinois Commerce Commission, a new low rate step of 1.6 cents per kilowatt-hour will be available to residential customers whose space heating facilities are exclusively electric. This is about 29% below the utility's lowest kilowatt-hour charge for general household uses of electricity. The former low rate for residential complete electric space heating was 1.75 cents per kwhr.

At the same time, C.E. reduced from 1.75 cents to 1.6 cents the maximum average kilowatt-hour charge for commercial, industrial and governmental electric space heating service. The revised electric heating rates, like all rates of the utility, are subject to a fuel adjustment clause.

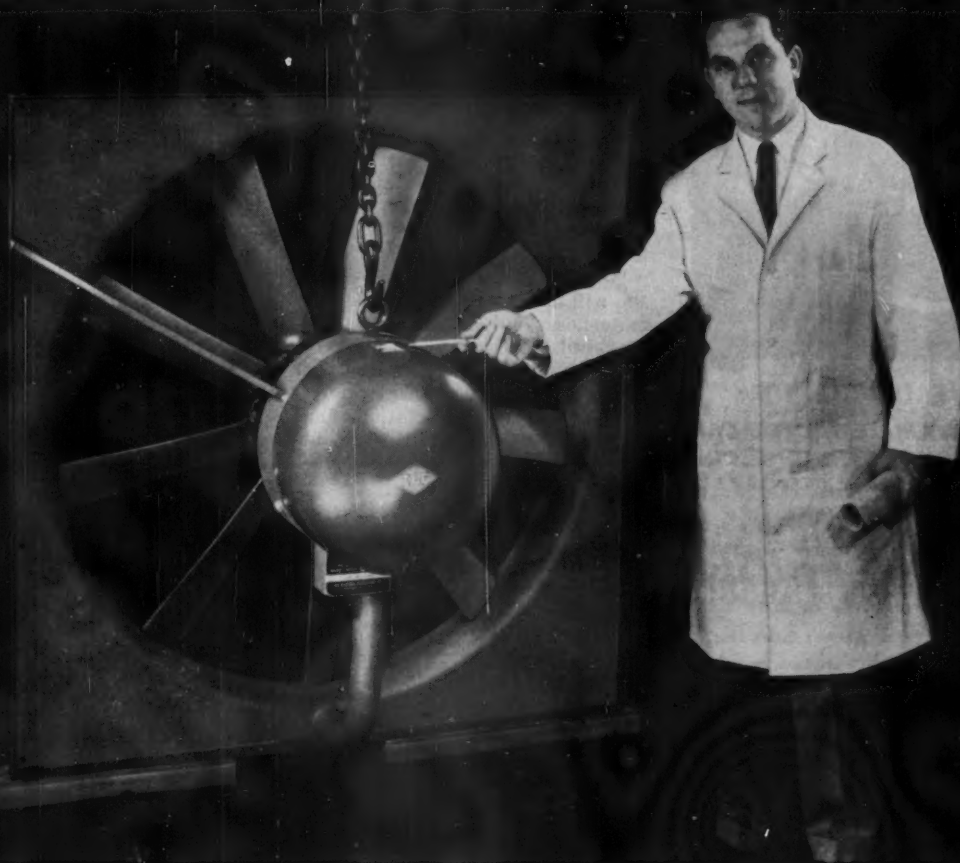




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## New Square Panel Propeller Fans move up to 37,550 CFM

You're looking at the new Ilg Type PF square panel propeller fans. Note the sturdily constructed 14-gauge steel mounting panel; the deep-throated streamlined orifice that increases fan efficiency; the choice of fan wheels—airfoil design blades (either five or nine) for operating against higher static pressures, and Ilg's patented Type "Q" blades for super-quiet operation on ordinary requirements.

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... no tamping.
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son has approximately 4,000 space  
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tion.

## News About EASA

Approximately 1,500 man-days  
will be spent by members of the in-  
dependent electrical apparatus serv-  
ice industry in EASA "schools"  
this year, it has been estimated by  
association officials planning the  
1961 Electronic Motor Control  
Courses to be held in various major  
cities in March, April and May.

A limit of 50 persons per five-day  
course in each of six cities will at-  
tend the sessions which will include  
lectures and discussions on basic  
electricity, basic electronics, basic  
motor action, the Ward Leonard  
system, control of motor and gener-  
ator field, reversing motor rotation,  
dynamic braking, variable speed  
control, internal circuitry, trouble-  
shooting methods, magnetic ampli-  
fiers, and several other topics.

An enrollment fee of \$65 per per-  
son will include text and laboratory  
materials, equipment rentals and  
overhead. Reservations should be  
sent promptly to EASA Engineer  
August A. Baechle, Electrical Ap-  
paratus Service Association, Inc.,  
7730 Carondelet Avenue, St. Louis  
5, Mo.

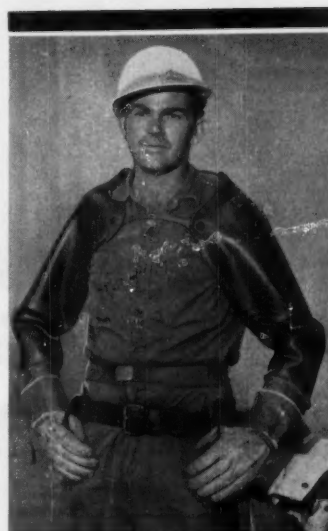
• • • • •

Christmas parties — traditional  
events for many EASA chapters—  
were held in December by Central  
Ohio Chapter, in Columbus; by  
Great Lakes Chapter, in Detroit; by  
Los Angeles Chapter, in Anaheim,  
Calif.; by Mid-South Chapter, in  
Memphis, Tenn.; Northern Califor-  
nia Chapter, in Oakland; and  
Quaker City Chapter, in Phila-  
delphia.

• • • • •

This column is headed "News  
About EASA" rather than "NISA  
News" because the official name  
change of the organization—to  
Electrical Apparatus Service As-  
sociation, Inc., from National In-  
dustrial Service Association, Inc.—  
is only a little more than two  
months away. On April 1, 1961, the  
change becomes official, and NISA  
—oops!—EASA officers and spokes-  
men are being instructed to use the  
new name whenever possible.

The new name was chosen more  
than a year ago by the association's  
board of directors as one more de-  
scriptive of the work performed by  
its membership. The association



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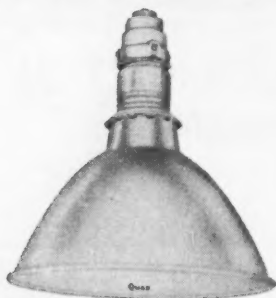
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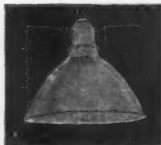


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originally was founded as "National Industrial Electrical Service Association," then the word "Electrical" was dropped when the membership ranks were opened to the mechanical trades, firms now no longer eligible for membership.

The association's industrial show exhibit was displayed at the recent National Conference on the Application of Electrical Insulation, held in Chicago last December. The exhibit will also appear this month at the Plant Maintenance & Engineering Show in the same city.

An appeal to amateur radio operators (hams) from Earl Brooks, of United Electric Motor Service, Seattle, Wash., owner of station K7BKZ, has been made with the hope of organizing an EASA network of stations. Motor shop operators who also own amateur stations include Tony Kuzniewski, of Quality Electric Service, Milwaukee, Wis., and Jimmy Roper, C & H Electric Co., Miami, Fla. Others are invited to send their QSL cards to Mr. Brooks, United Electric Motors, 308 9th Avenue North, Seattle 9, Wash.

Another EASA auxiliary that might be formed could be one of women motor shop operators. There are several who devote full time to managing an electrical business, including Mrs. Cecelia Forest, Quality Electric Co., Inc., San Francisco, Calif.; Mrs. William Finkernagel, Electric Motor Repair Service, Milford, Del.; Mrs. W. C. Johnson, Newby Electric Co., Pasacagoula, Miss.; Mrs. George F. Cannon, Cannon Electric Co., Bellingham, Wash.; and Mrs. Eleanor M. Hust, Pleasant Electric Co., Cincinnati, Ohio. Any others?

New EASA members include S & M Electric Service, Garnett, Kansas; Ted's Motor Shop, Lexington, Neb.; Power-Control, Inc., Pendleton, Oregon; and Armatures, Inc., Warren, Mich.

Exhibitors at the forthcoming San Francisco Convention of EASA, June 11-14, 1961, should write Joseph M. Harrington, executive vice-president of NISA-EASA, 7730 Carondelet Av., St. Louis 5, Mo., for information.

The 1962 EASA Convention will be held at the Conrad-Hilton Hotel in Chicago, June 3-7, 1962.

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Comprehensive compendium of today's scientific and technology knowledge, containing more than six million words, 10,000 illustrations, and 7,200 authoritative articles written by more than 2,000 contributors under the supervision of 63 prominent consulting editors. It covers all fields of engineering, life science, physical science, earth science, and their application to specific modern technologies. Typical subjects covered are electrical engineering, electricity, electronics, heat, industrial engineering, mathematics, control systems, mechanical power, and machine design. There will be a continuous revision program to keep the set up-to-date, as well as an annual supplement.

**Lighting Handbook**, Revised Edition, 250 pages, \$3.00, Lamp Division, Westinghouse Electric Corp., Bloomfield, N. J.

Comprehensive coverage of the general field of modern lighting practices, including a fold-out page in full color of the electromagnetic spectrum, information on distribution and light measurements, a section on the newest light sources, and tables of coefficients of utilization, maintenance factors, and footcandle levels.

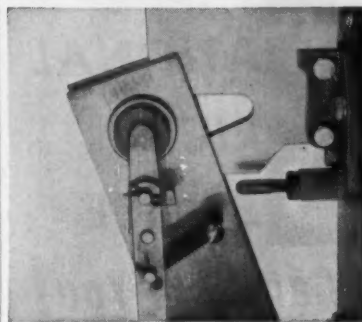
**Principles of Engineering Economy**, by Eugene L. Grant and W. Grant Ireson; 4th Edition, 574 pages, \$8.00. Ronald Press Co., 15 E. 26th St., New York 10, N. Y.

A prime aid for engineers and engineering executives responsible for crucial monetary decisions. It describes how to put together a modern economy study to reach reliable spending policies.

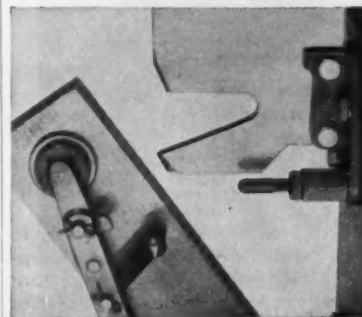
**Electronics and Nucleonics Dictionary**, by Nelson M. Cooke and John Markus; 543 pages, \$12.00. McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y.

Definitions of more than 13,000 terms used in the electronics and nucleonics fields, showing the exact meaning and correct usage of technical words, synonyms, and abbreviations currently being used in such areas as radio, radar, industrial electronics, medical electronics, space electronics, nuclear science, and nuclear engineering.

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The performance of the Pringle switch is a matter of record. Proven in laboratory tests. Confirmed by the fact that many of them have been in service for more than 25 years. The entire story—including models, ratings and load-break test data—is in the Service Entrance Catalog. A copy is yours upon request.

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**Practical Electrical Wiring**, by H. P. Richter; Sixth Edition, 592 pages, \$7.95. McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y.

Practical methods for handling wiring and installation jobs on the farm, in homes, factories, stores, schools, and other structures. In addition, the manual includes hundreds of on-the-job tips and short-cut suggestions.

**1960-61 National Fire Codes**, 7 volumes, \$7.00 each; \$40.00 all seven volumes. National Fire Protection Assn., 60 Batterymarch St., Boston 10, Mass.

Latest clothbound reference volumes containing complete, current texts of all NFPA standards on every phase of fire protection and fire prevention. Volume titles include Flammable Liquids and Gases; Combustible Solids, Dusts, Chemicals and Explosives; Building Construction and Equipment; Fixed Extinguishing Equipment; Electrical; Transportation; and Mobile Fire Equipment, Organization and Management.

**American Standards Assn.**, 10 East 40th St., New York 16, N. Y.

*Recommendation for Commercial Annealed Aluminum Electrical Conductor Wire* (International Electrotechnical Commission Publication 21); 80 cents.

*Recommendations for Aluminum Electrolytic Capacitors for General Purpose Applications* (International Electrotechnical Commission Publication 103); 40 cents.

**National Electrical Manufacturers Assn.**, 155 E. 44th St., New York 17, N. Y. (NEMA Standards):

AD 1-1960: *Adsorption Equipment* (Dehumidifiers); 40 cents.

EI 15-1960: *AEIC-EEI-NEMA Standards for Thermal Demand Meters*; 50 cents.

EI 17-1960: *AEIC-EEI-NEMA Standards for Watthour Meter Sockets*; 75 cents.

FB 1-1960: *Conduit and Cable Fittings and Accessories*; 40 cents.

HU 1-1960: *Industrial Heating Units and Devices*; 30 cents.

HV 1-1960: *Summary of Characteristics of Apparatus Insulators*; 25 cents.

SG 2-1960: *High-Voltage Fuses*; \$3.00.

TR 1-1960: *Transformers, Regulators and Reactors* (Compilation of all transformer standards in one volume); \$1.00.

CN 1-1960: *Room Air Conditioners*; 30 cents.

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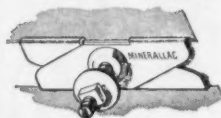
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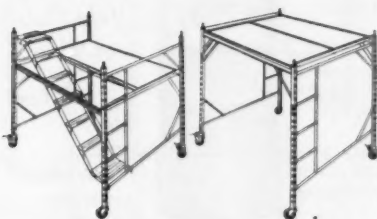
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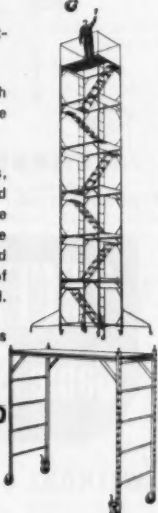
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SH 3-1960: *EEI-NEMA Standards for Voltage Classification of Luminaires Used in Street and Highway Lighting*; 25 cents.

IC 2-1960: *Resistance Welding Control*; \$1.00.

Edison Electric Institute, 750 Third Ave., New York 17, N. Y.:

*Application Guide for Automatic Oil Circuit Reclosers* (Publication No. 60-52); 60 cents.

Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.:

*Recommended Practice for Office Lighting*, 36 pages; 50 cents.

U. S. Dept. of Commerce, National Bureau of Standards, Washington 25, D. C.:

*Conductive Flooring for Hospital Operating Rooms*, by Boone, Hermach, Mac Arthur, and Mc Auliff, 16 pages; 20 cents.

Better Light Better Sight Bureau, 750 Third Ave., New York 17, N. Y.:

*Lighting for Industry* (Form No. B-570), 16 pages; 25 cents (under 100 copies); \$20 per hundred (up to 1000 copies); \$180 per thousand (1,000 or more copies).

American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.:

*Symposium on High-Voltage Cable Insulation* (STP 253); 39 pages, \$1.50.

Building Research Advisory Board, National Academy of Sciences, National Research Council, 2101 Constitution Ave., Washington 25, D. C.:

*Refrigerated Storage Installations* (Federal Construction Council Technical Report No. 38); \$2.00.

Air-Conditioning and Refrigeration Institute, 1346 Connecticut Avenue, N. W., Washington 6, D. C.:

*Refrigerant 12 and Refrigerant 22 Compressors and Compressor Units* (ARI Standard 516-60); 50 cents.

*Ammonia Compressors and Compressor Units* (ARI Standard 511); 50 cents.

Residential Market Development Operation, General Electric Co., 2100 Linden Ave., Zanesville, Ohio:

*Step Into a Bright New World* (Uses of electricity in a Medallion Home); 32 pages; 15 cents each, \$8 00 per hundred.

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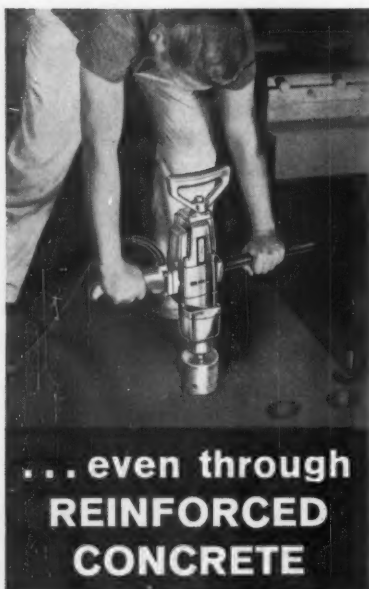
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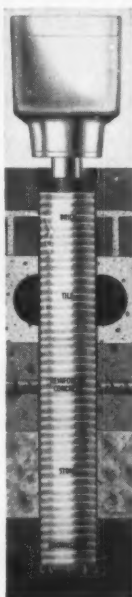


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## DATES AHEAD

**Industrial Heating Equipment Association, Inc.**—Dearborn Inn, Dearborn, Mich., January 23-24.

**Plant Maintenance and Engineering Show**—International Amphitheatre, Chicago, Ill., January 23-26.

**American Institute of Electrical Engineers**—Winter General Meeting, Hotel Statler, New York, N. Y., January 29-February 3.

**Intermountain Electrical Association**—Annual conference, Hotel Ben Lomond, Ogden, Utah, February 2.

**Power & Communications Contractors Association**—Annual convention, Sir Francis Drake Hotel, San Francisco, Calif., February 5-7.

**National Electrical Week**—National promotion, February 5-12.

**National Rural Electric Cooperative Association**—19th annual meeting, Dallas, Texas, February 13-16.

**15th International Heating & Air-Conditioning Exposition**—International Amphitheatre, Chicago, Ill., February, 13-16.

**3rd Biennial Electrical Trade Conference and Exposition**—Sheraton-Park Hotel, Washington, D. C., February 14-16.

**Upper Midwest Electrical Industry Convention**—Leamington Hotel, Minneapolis, Minn., February 19-22.

**National Electric Sign Association**—Convention, Benjamin Franklin Hotel, Philadelphia, Pa., Feb. 19-22.

**Electrical Show**—1961 Denver Electrical and Electronics Exhibit, Denver Hilton, Hotel, Denver, Colo., February 21-22.

**17th Annual National Wiring Sales Conference**—Sherman Hotel, Chicago, Ill., February 23-24.

**3rd National Lighting Exposition and World Light Forum**—Coliseum, New York City, N. Y., March 8-15.

**Edison Electric Institute**—Annual sales conference, Edgewater Beach Hotel, Chicago, Ill., March 20-22.

**American Power Conference**—Sherman Hotel, Chicago, Ill., March 21-23.

**Nebraska Iowa Electrical Council**—4th Biennial Nebraska-Iowa Electrical Trade Show, Peony Park Auditorium, Omaha, Neb., March 21-23.

**International Association of Electrical Inspectors**—Chapter Meetings—Mississippi, Heidelberg Hotel, Jackson, Miss., March 27-28; Georgia, Forrest Hotel, Rome, Ga., April 10-11; Ellis Cannady, Carolina Hotel, Raleigh, N. C., April 12-13; Alabama, Tutwiler Hotel, Birmingham, Ala., April 17-18; South Carolina, Cabana Inn, Spartanburg, S. C., April 20-21; Five Chapter Joint Meeting, Windsor Hotel, Abilene, Texas, April 28-29; Florida, Casa Marina Hotel, Key West, Fla., May 5-6; Virginia, Hotel Roanoke, Roanoke, Va., June 12-13; Northwestern Section, Owyhee Hotel, Boise, Idaho, Sept. 11-13; Southwestern Section, Hotel Del Coronado, Coronado, Calif., September 18-21; Western Section, Biltmore Hotel, Oklahoma City, Okla., September 25-27; Canadian Section,

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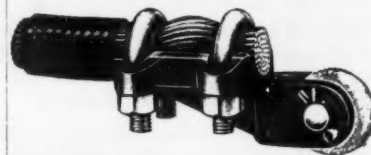
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Toronto, Ont., September 29-30;  
 Eastern Section, Warwick Hotel,  
 Philadelphia, Pa., October 9-11;  
 Southern Section, Grove Park Inn,  
 Asheville, N. C., October 16-18.

**Electrical Supply Trade Show**—Sponsored by the Electrical Association of Kansas City, Exhibition Hall, Municipal Auditorium, Kansas City, Mo., March 28-30.

**Electrical Trade Show**—Sponsored by St. Louis Electrical Board of Trade, April 4-6.

**Northern California Electrical Industry Show**—Sponsored by the Electrical Maintenance Engineers' Association of Northern Calif., Brooks Hall, San Francisco, Calif., April 5-9.

**1961 Electrical Home Show**—Community War Memorial, Rochester, N. Y., April 8-15.

**Missouri Valley Electrical Association**—Annual engineering conference, Hotel President and Municipal Auditorium, Kansas City, Mo., April 12-14.

**2nd Annual Alabama Electrical & Electronics Exposition**—Birmingham Municipal Auditorium, Birmingham, Ala., April 17-19.

**National Association of Electrical Distributors**—53rd annual convention, Detroit, Mich., April 29-May 3.

**National Fire Protection Association**—Annual convention, Hotel Statler, Detroit, Mich., May 15-19.

**Edison Electric Institute**—Annual convention, New York, N. Y., June 5-7.

**Electrical Apparatus Service Association, Inc.**—28th annual convention, Jack Tar Hotel, San Francisco, Calif., June 11-14.

**New York State Association of Electrical Contractors & Dealers**—62nd annual convention, Whiteface Inn, Lake Placid, N. Y., July 2-7.

**Western Plant Maintenance Show**—Pan American Auditorium, Los Angeles, Calif., July 18-20.

**National Assn. of Lighting Maintenance Contractors**—National conference, Las Vegas, Nev., August 21-23.

**Western Electronic Show and Convention**—Cow Palace, San Francisco, Calif., August 22-25.

**American Home Lighting Fixture Month**—Sponsored by the American Home Lighting Institute, Chicago, Ill., September 1-30.

**Illuminating Engineering Society**—National Technical Conference, Chase Park Plaza Hotel, St. Louis, Mo., September 24-29.

**International Association of Electrical Leagues**—25th Annual Conference, President Hotel, Atlantic City, N. J., October 4-6.

**Canadian Electrical Manufacturing Association**—Annual meeting, Sheraton Brock Hotel, Niagara Falls, Ontario, October 4-6.

**17th Annual National Electronics Conference**—International Amphitheatre, Chicago, Ill., October 9-11.

**National Electrical Contractors Association**—Annual convention, Washington, D. C., October 9-14.

**National Electrical Manufacturers Assn.**—Annual meeting, Traymore Hotel, Atlantic City, N. J., Nov. 13-17.

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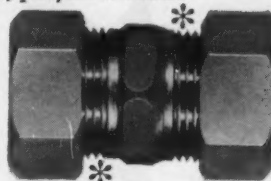
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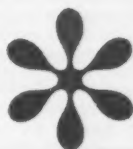


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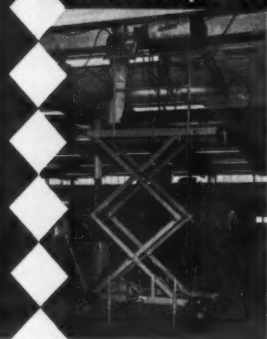
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## Among the Manufacturers

### Headquarters Announcements

**Keystone Mfg. Co.**, Warren, Mich., has announced the acquisition of **Calcon Mfg. Co.**, Washington, Pa. R. L. Chandler is president, and Arthur H. Lassers is general sales manager.

**General Electric Co.**, Schenectady, N. Y.—Richard T. Perkins, manager of foreign business operations, and Marshall Anderson, manager of manufacturing, General Purpose Control Dept., Bloomington, Ill.; Walter N. Shambach, manager of marketing and product development, Heaters and Devices Section, Industrial Heating Dept., Shelbyville, Ind.; A. G. Woodside, manager of marketing, Instrument Dept., West Lynn, Mass.

**H. K. Porter Co., Inc.**, Pittsburgh, Pa.—A. Campbell, Jr., manager of sales and marketing services, Thermoid Div.

**Daystrom, Inc.**, Newark, N. J.—Harold L. Russell, general sales manager, Weston Instruments Div.

**Thor Power Tool Co.**, Aurora, Ill.—Robert G. Faverty, vice president and general manager.

**Rotax Inc.**, Los Angeles, Calif.—David H. Thomas, president.

**Mathias Klein & Sons, Inc.**, Chicago, Ill.—H. B. Wilson, general sales manager.

**General Electric Co.**, Plainville, Conn.—William W. Smith, manager of marketing, Circuit Protective Devices Dept.

**General Electric Co.**, Waterford, N. Y.—Bryce I. MacDonald, Jr., manager of manufacturing engineering, Silicone Products Dept.

**Tork Time Controls, Inc.**, Mt. Vernon, N. Y.—Gilbert R. Haring, marketing manager, Industrial Controls Sales Div.

**Homelite, Div. of Textron Inc.**, Port Chester, N. Y.—Robert P. Straetz, vice president and sales manager.

**Thiel Tool & Engineering Co.**, St. Louis, Mo.—Clifford Becker, product engineer and sales manager.

### Regional Appointments

#### NEW ENGLAND

**National Elec. Div.**, H. K. Porter Co., Inc., has moved its Boston branch office to 157 Federal St.

**The Wiremold Co.**: William E. Parks, district sales manager for state of Connecticut.

**Daniel Woodhead Co.**: J. B. Gleason, Boston, Mass., represent-





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ative for Maine, New Hampshire, Vermont, eastern Massachusetts, and Rhode Island.

### MIDDLE ATLANTIC

**Corning Glass Works:** Frederick F. Fleischman, Jr., district sales manager of new Pittsburgh, Pa. office, Technical Products Div.

**Chase & Sons, Inc.:** J. F. Postell Co., Cranfield, N. J., sales representative for New Jersey and surrounding counties in Pennsylvania and New York.

### SOUTH ATLANTIC

**Paine Co.:** Hale F. Thomas, Daytona, Fla., sales representative in Florida.

**Typhoon Heat Pump Div., Hupp Corp.:** Roland E. Pillat, sales manager, headquarters in Tampa, Fla.

**Sola Electric Co.:** Richard H. Wheelock, sales engineer in new Washington, D. C., district office.

### EAST CENTRAL

**Sola Electric Co.:** Donald E. Henderson, sales engineer in Cleveland district office.

**Westinghouse Electric Corp.:** David L. Litten, sales manager, Lighting Div., Cleveland, Ohio.

**Wheatland Electric Products Co.:** Frank King, midwestern sales manager, headquarters in Chicago.

**Frank Adam Electric Co.:** E. J. Redmond and Associates, Cincinnati, Ohio, representative in Kentucky and southern Ohio.

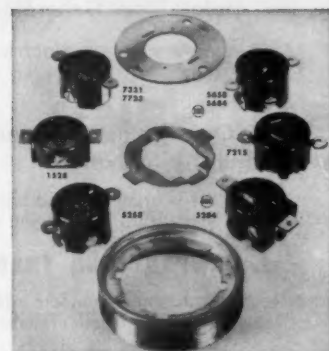
### WEST CENTRAL

**Wolverine Tube:** George F. Wallace, representative for northwest section of Texas with headquarters in Dallas.

**The Fisher-Pierce Co.:** David R. Hill Co., Hastings, Neb., sales rep-



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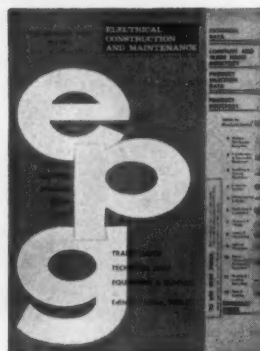
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| Wiring Devices & Boxes         | Heating & Cooling Equip.     |
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Covers electrical symbols, diagrams, definitions, tables, formulas, and practical calculations used in electrical construction.

\* Subscribers received the Mid-September 1960 EPG as part of their regular service. A few extra copies are still available—when they are gone no more will be printed until next year's edition. Order several copies for your office and staff—only \$2.50 per copy.

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Company Name . . . . .

Home ☐

Address—Company ☐ . . . . .

City . . . . . Zone . . . . . State . . . . .

Please indicate—

Nature of Co. Business . . . . .



**C. E. SCHAAD**, State Superintendent of the Bureau of Electricity, NY Board of Fire Underwriters, New York City, had a busy schedule as a member of a number of committees that planned the Eastern Section IAEI meeting, held recently in Portsmouth, N. H.

representative for all of Nebraska.

**Keystone Manufacturing Co.:** Dupont-Bondurant, Inc., New Orleans, La., sales representative in Louisiana and southern Mississippi; Malcolm Kueneman, West Memphis, Ark., sales representative for Arkansas, northern Mississippi, western Tennessee and Dunklin and Pemiscot counties in Missouri.

**The Wakefield Co.:** Jay Johnston, representative for the Kansas City, Mo., and Kansas areas.

#### WEST

**National Carbon Co.:** Rolf Lindenhayn, Jr., western division manager of brush and railroad products.

**Columbia Cable and Electric Corp.:** Bergman-Marshall Co., Inc., San Francisco, agent representative for state of California.

**Westinghouse Electric Corp.:** John E. Noren, Jr., San Francisco district manager, Elevator Div.

**Allen-Stevens Conduit Fittings Corp.:** Bergman-Marshall Co., Inc., San Francisco, representative for the northern California area.

**The Fisher-Pierce Co.:** T. R. Van Wagoner Co., Salt Lake City, Utah, sales representative for all of Utah, southern Idaho, and western Wyoming; Hamilton Associates, Denver, Colo., sales representative for all of Colorado and New Mexico, eastern and central Wyoming and El Paso area of Texas.

**Halo Lighting Products, Inc.:** The George Adams Co., Phoenix, Ariz., representative for New Mexico, Arizona and El Paso, Texas.

**Sola Electric Co.:** Gordon Osborne, sales engineer in Los Angeles district office.

## SEARCHLIGHT SECTION

(Classified Advertising)  
EMPLOYMENT + BUSINESS  
EQUIPMENT — USED OR RESALE  
OPPORTUNITIES

### DISPLAYED RATE

EQUIPMENT & BUSINESS OPPORTUNITY  
Advertising \$21.00 per inch

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on one column, 3 columns—30 inches—to a  
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From Chicago you can get immediate  
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Order today. We ship same day.

Send for our latest stock sheet

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Dept. ECM

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### POSITION VACANT

Washington, D. C. Consulting engineering  
firm has position for electrical engineer  
exper. in design of buildings. Send complete  
resume of educ. exper. and sal. reqts. P-  
5840, Electrical Construction & Maintenance.

### SELLING OPPORTUNITY WANTED

Wanted: Wanted: Wanted. All kinds of elec-  
trical supplies and equipment to sell in  
Southern Indiana & the state of Kentucky.  
Universal Electric. JU 3-1880, Louisville,  
Ky.

### BUSINESS OPPORTUNITY

For Sale—Electrical Contracting & Retail  
Business in the heart of a small mid-western  
town with assured rapid industrial growth.  
Owner must sell to devote full time to other  
interests. BO-5807, Electrical Construction  
& Maintenance.

### Your Inquiries to Advertisers Will Have Special Value . . .

—for you—the advertiser—and  
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highly this evidence of the publi-  
cation you read. Satisfied adver-  
tisers enable the publishers to se-  
cure more advertisers and—more  
advertisers mean more informa-  
tion on more products or better  
service—more value—to YOU.

## TOTAL ELECTRIC HOME STIMULATES PUBLIC INTEREST

(FROM PAGE 89)

located along the outside walls of  
the 1587-sq-ft home. Heaters in  
each room contain integral ther-  
mostats for comfort regulation as  
desired. Ceiling insulation consists  
of 6 in. of Rockwool batts with 4  
in. placed in walls. Vapor barriers  
are installed in both walls and  
ceiling.

The central air conditioning is  
located in a small basement area  
provided for this unit and the elec-  
tric water heater. Complete with  
a Precipitron unit, the central a-c  
unit cools, cleans, dehumidifies,  
circulates and ventilates for op-  
timum results. Also exhaust fan  
equipment is installed in the kitch-  
en, bath and laundry areas.

Facing the dining area, an elec-  
tric barbeque unit, complete with a  
pushbutton fan-hood ventilator and  
motorized spit, offers a practical in-  
door barbeque ensemble.

### Nation-Wide Program

The Canton home is one of 15  
different type residences built dur-  
ing 1960 as the result of the West-  
inghouse nation-wide program. To  
illustrate to the public the advan-  
tages of using electricity as the only  
source of energy in a house, West-  
inghouse commissioned five leading  
architectural firms from different  
parts of the United States. Their  
total electric program includes de-  
tailed plans for any of the 15  
homes, which cover virtually every  
housing requirement.

From the results already in, the  
program has been responsible for  
starting several thousand of these  
Total Electric Homes in various  
parts of the country. And such  
homes provide extra profit for elec-  
trical contractors who realize the  
advantage of promoting Total Elec-  
tric Living in their area.

The efforts of the Ohio Power  
Company contributed considerably  
to the successful promotion of the  
Canton Total Electric Home. Favor-  
able public reaction was the result  
of close cooperation among the  
architect, builder, electrical contrac-  
tor, power company, and manufac-  
turer.

Throughout the nation, Total  
Electric Living is on the upswing  
in response to public demands,  
stimulated by the electrical indus-  
try's promotional programs.



## ONE-TIME FUSE

(Silver-Plated)

The only AC Rated One-Time,  
tested and proven on AC.

U.L. Approved. Competitively  
Priced. Order now for

Predictable Performance.



ask for bulletin O-T 601

THE CHASE-SHAWMUT CO.

Subsidiary of I-T-E CIRCUIT BREAKER CO.

374 MERRIMAC STREET • NEWBURYPORT, MASSACHUSETTS



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## MECHANICAL- ELECTRICAL EQUIPMENT HANDBOOK for SCHOOL BUILDINGS

By HARRY TERRY, Consulting Engineer

A new, easy-to-use guide on various  
kinds of school equipment and their  
operating characteristics. Gives detailed  
instructions for supervising installation,  
actual operating instructions for typical  
existing school buildings, and procedures  
for maintenance of mechanical and elec-  
trical equipment. Describes activities of  
the project inspector, duties of the archi-  
tect-engineer team, and includes a Con-  
tractor's Administrative Manual. 1960.  
424 pages. \$9.50

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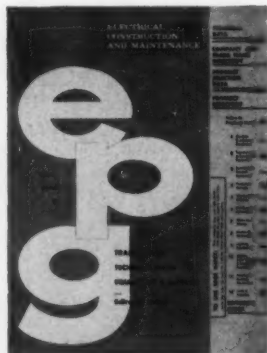
JOHN WILEY & SONS, Inc.

440 PARK AVENUE SOUTH  
NEW YORK 16, N. Y.



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• These manufacturers advertised their products in the **ELECTRICAL PRODUCTS GUIDE ISSUE**

For more complete information, and application data on their lines, refer to the index of Advertisers in the **ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.**



design leadership



## NOW! LOW-COST MAGNETIC CONTROL FOR DC CRANES

*Compact **EC&M Type "PT" Control**—a logical replacement for manual control*

• On any DC crane application up to 55 hp, 230 volts, you now can have all the advantages of *full magnetic control* where manual control formerly was purchased purely on the basis of price. Whether you're modernizing existing cranes or ordering new ones, you'll find type "PT" control far superior to manual control.

**Space Saving** • compact controllers fit easily in crane cabs, on crane walkways and in congested areas for other mill applications. Front connection permits mounting against walls or girders.

**Full Protection** • now available with self-contained undervoltage and overload protection. Also supplied without protection for use with separate protective panel.

**Extra Safety** • Exclusive Wright dynamic lowering cir-

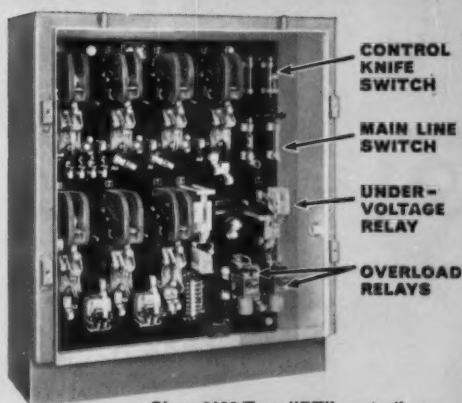
cuit is the simplest and safest circuit for crane hoist service, gives maximum hook speed without danger of overspeeding. Controller completely enclosed.

**Automatic Acceleration** • relays adjustable from 0.2 second or more per step. Automatic acceleration reduces wear on motors and control.

**Plugging Protection** • rectifier-type plugging relay operates from motor counter-emf.

**Choice of Master Switches** • dynamic lowering controllers furnished with 4-point speed control. Choice of 3 or 4 point master switches on reversing plugging controllers.

**Heavy-Duty Construction** • mill-type contactors, sturdy design throughout make Type "PT" control suitable for mill accessory drives as well as light industrial cranes. Available in NEMA Type 1 general purpose, Type 1 gasketed, or NEMA Type 3 weatherproof enclosures.



Class 6132 Type "PT" controller with self-contained protection

*Write for Bulletin 6132 for details on "PT" control with protection*



### SQUARE D COMPANY

EC&M DIVISION • CLEVELAND 28, OHIO

wherever electricity is distributed and controlled



*"Quick...pull the plug! It won't flash...it's a*

## ***CROUSE/HINDS Arktite***

No matter what the atmosphere . . . no matter what the load . . . you don't have to fumble for a disconnect switch . . . or run to cut the power. You can make or break *Arktite* connections in any emergency . . . under any condition . . . with complete safety.

There's never an exposed flash. *Arktite* plugs and receptacles snuff out arcs in deep, flame-tight chambers. Separate chambers for each pole! And ground poles are first to contact, last to break.

Safe against careless plug-ins, too. You can't mis-mate them . . . can't hook up different polarities! And they're tough, durable, weather-resistant, easy to wire and install.

Moreover, they eliminate need for that bothersome extra-step, the disconnect switch.

For long service and all-around safety, specify *Arktite* plugs and receptacles. Available in both explosion-proof and conventional design in a range of 20 to 400 Amps, at 250V D.C. or 600V A.C.

*Arktites* are listed in your Catalog 3000, along with many other types of Crouse-Hinds plugs and receptacles. See your Crouse-Hinds Distributor.



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